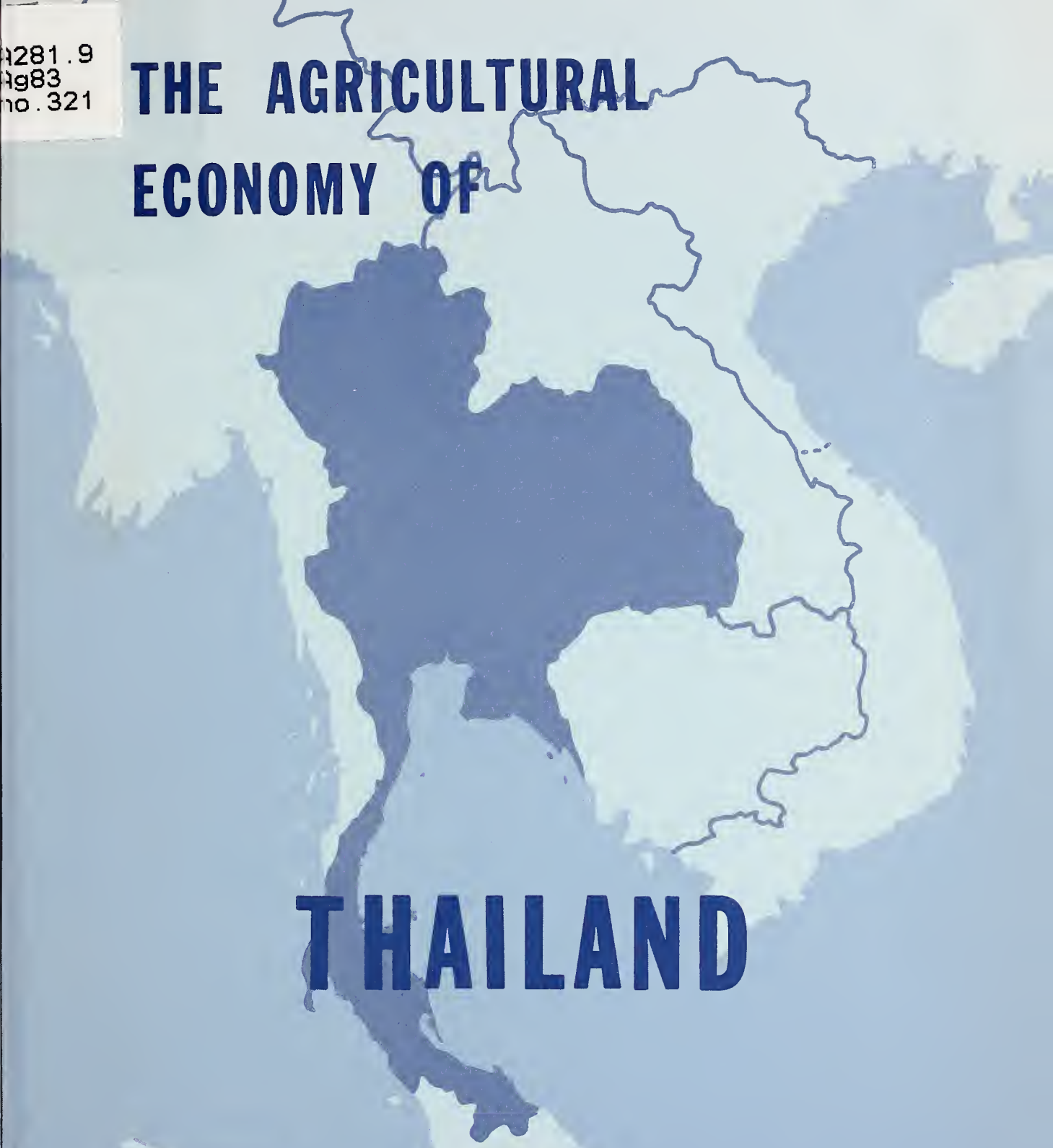
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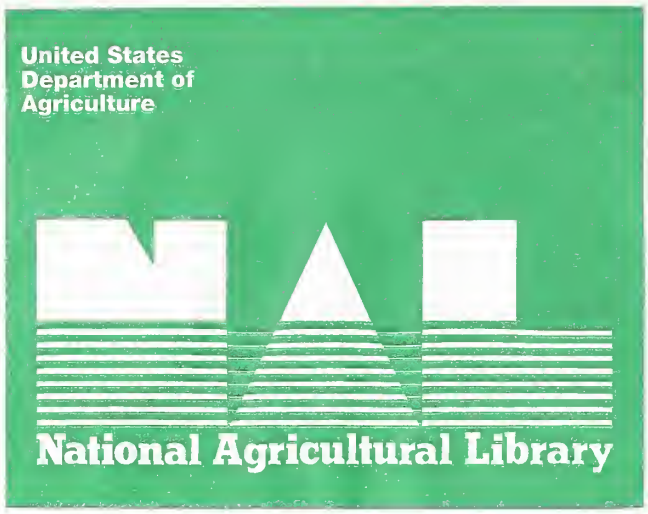
THE AGRICULTURAL ECONOMY OF



THAILAND

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Tradition… Thailand has achieved a rem…tinuing to expand rice pr…t than crop production. Th…and has also become a major …preparations--rubber, hard f… potential for further expans… important exporter of soybeans and possibly sorghum. With U.S. and other aid, the Thai Government is endeavoring to further expand and diversify farm production and bring the poorer farming regions closer to the economic level of the area near Bangkok, one of Asia's richest and most productive regions. Continued growth of agriculture is essential to Thailand's development, since farming remains the basis of the country's economy, although important progress has been made in other sectors. Thailand is a $34 million market (3-year average) for U.S. products of farm origin. It imports from the United States mostly unmanufactured tobacco ($18.9 million); cotton ($7.6 million); liquid beverage bases and flavoring extracts and sirups ($3.1 million); grains and preparations ($1.2 million); dairy products; and miscellaneous food preparations. Crude rubber is Thailand's major farm export to the United States.

Key words: Thailand, agricultural production, growth, diversification, rice exports, corn exports, agricultural policies, foreign aid.

PREFACE

Thailand is one of the few developing countries which is both a sizable dollar market for U.S. farm products and a leading exporter of a number of agricultural commodities, particularly rice and corn.

This report reviews the rapid expansion and diversification of Thailand's agricultural production and trade and surveys prospects of its farm trade with the United States and the rest of the world, as of mid-1971.

The author is indebted to many persons, both in the United States and Thailand, who provided helpful information and assistance, particularly Nancy Hancock, Thailand desk officer in the Far East Branch, Foreign Regional Analysis Division (FRAD), Economic Research Service (ERS), U.S. Department of Agriculture (USDA); and Linda M. Bailey, Special Projects Branch, FRAD, who compiled the tables and provided other statistical support. Elfriede Krause, Chief, Special Projects Branch, FRAD, ERS, provided overall direction and supervision.

Photographs came from three different sources. Figure 2, courtesy of Harry Walters, FRAD, ERS; figures 6, 8, and 13, courtesy of Food and Agriculture Organization, United Nations. The author supplied photographs for figures 3, 9, 10, 11, and 12. Maps were prepared by ERS.

The metric system was used for the most part. The equivalents of the units used are: 1 metric ton = 2,204.6 pounds; 1 quintal = 220.46 pounds; 1 kilogram = 2.2046 pounds; and 1 hectare = 2.471 acres.

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SUMMARY

Thailand's agriculture has grown significantly during the past two decades. Among factors stimulating the expansion and diversification of farm production have been the availability of new land, the generally favorable natural conditions, and a trade sector capable of responding to international market demands. As the Thai economy is essentially based on agriculture and related industries and services, continued economic development will depend largely on further agricultural growth and commercialization of farm production.

Since the early 1960's, the Thai Government has increasingly promoted agricultural development through economic plans and foreign aid that has come primarily from the United States. Goals include improving crop yields by adopting modern techniques, further diversifying production by emphasizing crops with good export potential, expanding irrigation, strengthening the institutional framework, connecting more rural areas with urban markets, and promoting regional specialization of production in commodities for which a given area has a comparative advantage. A major aim of regional specialization is to increase farm incomes in the poorer areas to bring them up to the economic level of the more prosperous parts of the country.

More than four-fifths of the value of Thailand's agricultural output comes from crops. Rice, traditionally the principal product, remains preeminent, but corn, rubber, cassava, kenaf, oilseeds, cotton, and sugarcane have rapidly gained in importance in the past 10-15 years.

Thailand is the world's second largest exporter of rice (after the United States); a large exporter of corn, natural rubber, and kenaf; a major source of cassava products; and a world leader in castor seed exports.

Japan, the largest single market for Thai farm exports, buys a considerable share of Thai corn and rubber. Though Japan's purchases of Thai corn declined in the late 1960's, they have recovered and may reach record levels in the 1971/72 marketing season. Taiwan has become another important outlet for corn. Asian countries other than Japan are the main buyers of Thai rice. In the long run, soybeans and sorghum could be large Thai exports to Japan.

The importance of the United States as a market for Thai agricultural commodities has declined because of a drop in U.S. demand for rubber from Thailand. However, Thai farm sales to the United States are picking up. Sugar, for example, is a new Thai product moving into the U.S. market.

By value, roughly two-fifths of Thai farm imports come from the United States, the largest single supplier. Thai purchases consist mainly of tobacco and cotton and also include relatively large amounts of liquid beverage bases, processed foods (including dried milk, most of which is for relief), and wheat and wheat flour. Australia and the Netherlands are the other two major sources of farm imports, providing mainly wheat and dairy products, respectively.

THE AGRICULTURAL ECONOMY OF THAILAND

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INTRODUCTION

The kingdom of Thailand is located in Southeast Asia, entirely within the northern tropical zone. With an area of 514,000 square kilometers (198,000 square miles), it is about three-fourths the size of Texas, or approximately as large as Spain.

Thailand's population, which has been increasing by about 3.1 percent annually, was approaching 35 million in 1969, according to official estimates (42). 1/ Roughly 85 percent of the people live in rural areas, mainly in farm households. More than half the urban population resides in the rapidly expanding Bangkok-Thon Buri metropolitan area, which has some 3 million inhabitants. Bangkok is Thailand's capital and by far its main industrial and commercial center. The next largest city, Chiang Mai, has fewer than 90,000 people.

Rivers and mountains divide Thailand into four main agricultural zones: Central, Northern, Southern, and Northeastern. The Central Zone, where Bangkok is located, is the richest of the regions and is one of the world's major rice-producing areas. The Northeastern Zone, which is not favorably endowed for agriculture, is the least developed region.

Theravada Buddhism is the established religion of Thailand. Only about 7 percent of the people adhere to other beliefs. Ethnic minorities (excluding the Lao) account for perhaps one-fifth of the country's total population (2). The Lao, who inhabit the north and the northeast, are a branch of the Thai people, but have some distinct cultural and ethnic characteristics. Some 5 million Chinese make up the largest of the non-Thai groups, but a considerable share of the ethnic Chinese are integrated into the Thai nation. Many Chinese, who are concentrated in the cities and towns, market agricultural products, but relatively few engage in farming. Other minorities include various ethnic groups in the northeast, the Hill Tribes in the north, and the Malay in the south.

AGRICULTURE IN THE THAI ECONOMY

Thailand is essentially an agricultural country. Although other sectors

1/ Underscored numbers in parentheses refer to items in Selected References at the end of this report.

of the economy are rapidly gaining in importance, economic activity centers largely on producing, marketing, and processing farm commodities.

Agriculture employs at least 76 percent of the labor force and provides some 73 percent of total export earnings. In 1969, the share of agriculture in the gross domestic product (GDP) was officially estimated at nearly 30 percent (including forestry and fisheries, which together accounted for about 5 percent of the GDP). However, Thai national account data do not adequately reflect the overall importance of agriculture in the economy, partly because the Government has had a policy of maintaining a low domestic price for rice, which is by far the major agricultural product. In GDP statistics, this low price results in a distorted relationship between the official value of agricultural commodities and the value of other goods and services.

The rate of growth of Thai agriculture is high, even on a per capita basis. From 1961-62 to 1969-70, the annual increase in total farm production averaged 4.9 percent, or 1.5 percent per capita (45). However, the nonagricultural sector of the economy has grown faster than agriculture and the share of farm production in the GDP has been declining. This share was officially put at more than 38 percent in 1961 and is programed to be down to 26 percent in 1971.

Thai agriculture consists primarily of crop production. Rice is not only the most important crop for domestic use, but also the country's principal export. The role of rice has been so dominant that until a few years ago, Thailand was essentially a one-crop economy.

Since the end of World War II and particularly since the mid-1950's, astonishing progress has been made in the diversification of crop production; Thailand is now also a large producer and exporter of rubber, corn, kenaf, tapioca products, and castor seed. Except for rubber, large-scale production of which began in the late 1940's, the new export crops were produced in negligible amounts as recently as the mid-1950's.

The most important agricultural products for which Thailand is dependent on imports, in part or almost entirely, are dairy products; certain types of tobacco; cotton; wheat (including flour); and miscellaneous food preparations, mostly of the convenience type. Dairy products are the largest farm import and the only type of food for which Thailand relies primarily on foreign sources of supply. Imports of wheat and wheat flour, while relatively large in value, account for only a small share of grain consumption. Foods of the convenience or luxury type are chiefly for the Bangkok market, foreign civilian residents, and tourists.

The United States is the leading foreign supplier of farm products, primarily through its sales of tobacco and cotton. The Netherlands supplies most of the dairy products, Australia most of the wheat. On the export side, Japan is now the largest buyer of Thai farm products; other Asian countries and the European Economic Community (EEC) also are important markets. Sales to the United States are now increasing, after a drastic decline through most of the 1960's.

The success of Thai agriculture in expanding and diversifying its production has contributed perhaps decisively to the remarkable economic develop-

ment of the country over the past decade. Agriculture created a large share of the resources on which the rest of the economy built its rapid growth--primarily by earning foreign exchange.

The economy as a whole has also been stimulated by other factors, such as the rapid expansion of exports of tin, a substantial increase in foreign investments, the rapid growth of tourism, and the injection of relatively large sums of U.S. dollars in connection with U.S. operations in Vietnam.

The relative abundance of agricultural production has resulted in a level of living for the Thai rural population which, except for some areas in the north and northeast, is normally higher than in most other underdeveloped countries. Although the average diet is limited in variety and low in protein--rice accounts for about 70 percent of caloric intake--few people face the threat of serious hunger. In years of poor crops, Thailand, far from having to resort to international relief shipments of food, has large quantities of rice left over for export.

Thai farmers have sold some rice commercially for more than a century. A large proportion of farmers grow some other crops for the market.

Rubber and kenaf are produced exclusively for the market, and only small quantities of corn and cassava are retained by the farmers. Hogs and poultry, particularly ducks, are also a source of cash income. Water buffaloes and cattle are kept primarily for draft purposes, but farmers in the northeast generally raise these animals for sale to the Bangkok area and the south.

Most of the farm production marketed domestically and virtually all farm exports other than rubber are handled from Bangkok. Through the improvement and extension of transport facilities, particularly since the mid-1950's, Bangkok has been connected with the more remote areas of the country where farmers had formerly produced almost exclusively for subsistence.

While some of the new crops--for example, sugarcane and cotton--are marketed primarily for domestic consumption, the development of the money sector of agriculture is closely linked to the export trade. This trade began in 1858 with the signing of the Bowring Treaty with Great Britain (9). The export trade first stimulated the partial commercialization of rice; then, soon after World War II, it gave impetus to the production of rubber; and since the mid-1950's, the trade has encouraged planting of the newer crops such as corn, cassava, kenaf, and castor seed. At present, the prospect of finding profitable markets in Japan is providing some incentive for the expansion of oilseed cultivation.

Because Thai crops such as rice, rubber, corn, cassava, and castor seed rely largely or almost entirely on foreign markets for commercial outlets, and since the export outlook for most of the Thai crops is uncertain, a large share of Thai foreign exchange earnings and the cash income of many Thai farmers depend somewhat precariously on the vagaries of world markets and competition.

In line with its stated objective of providing reasonable returns to producers, the Government has a policy of guaranteeing minimum farm prices for rice, corn, kenaf, cotton, and sugarcane. However, floor prices set by the

Government generally have been lower than those prevailing in the market; Government purchases for purposes of price support have been minimal. Also, for rice, the aim of assuring fair returns to producers conflicts with the Government's other objective of keeping the consumer price low. It is said that since rice accounts for a considerable share of consumer expenditures, high prices for this commodity would unavoidably put inflationary pressures on all salaries and wages and, through them, on all costs in the nonagricultural sector of the economy.

A heavy tax on rice exports--the so-called rice premium--has been a major factor in keeping domestic prices of rice at artificially low levels. However, to revive falling exports, the Government has abolished the premium on foreign sales of most types of rice. Elimination of the tax may also result in higher farm prices for rice and may help bridge the wide gap between farm and nonfarm incomes.

Except in some areas in the Central Zone, land reform is not considered a primary need, as almost 82 percent of the farmers own all or at least part of the land they work.

Government agricultural policies have been aimed at increasing productivity as well as expanding and diversifying production. An effort is being made to promote the use of modern farming requisites and techniques. The infrastructure and the institutional framework are also being improved and strengthened. Crop yields remain low, however, even when compared with those in a number of other Asian countries. Past increases in production were brought about in Thailand almost exclusively by expanding the cultivated area, but now land is becoming scarce and farms are getting smaller. Thus, technological improvements are essential, if agriculture is to continue to grow at a satisfactory rate.

Expansion and improvement of irrigated farming during both the wet and dry seasons is a major goal of the Government's program for agricultural development. Lack of water for irrigation during the dry season, as well as inadequacy of the water supply during dry spells in the rainy season, has held farm production down to a fraction of its potential. Because of Thailand's tropical location, crops could be grown year round if water were available. Thus far, however, irrigation outside the Central Zone has been almost exclusively supplementary and production has been virtually limited to one crop a year grown in the rainy season.

In line with the Thai Government's aim to bring the poorer regions of the country closer to the economic level of the relatively prosperous Central Zone, several regional development projects in the poorer areas have also been undertaken. More emphasis on regional development and specialization is anticipated under the Third Development Plan.

Financial and technical help from the United States and, to a much lesser degree, from international organizations and other nations are making it possible for Thailand to speed up its agricultural development. Foreign private investment in the agribusiness sector is also encouraged. Japanese private interests are significant in the commercialization of Thai agriculture. Several American firms are also making a contribution in this direction by

participating in the establishment of agriculture-based industries. Sectors in which private American investments have been made include textile manufacturing; food processing; manufacturing milk products; manufacturing tobacco products; distributing imported packaged and canned foods; importing and exporting grain; manufacturing, importing, and distributing feed, feed supplements, animal health products, and agricultural chemicals; weaving and marketing silk and cotton; and distributing and servicing farm machinery.

For the next several years, Thai agriculture can be expected to remain the basis for the nation's overall economic development. The outlook is generally good because of the Government's apparent determination to increase farm production and promote the welfare of the rural population; the reported capability of the farmers (despite widespread illiteracy) of adopting new production methods when shown how; and the relatively favorable natural conditions.

PHYSICAL ENVIRONMENT

Topography

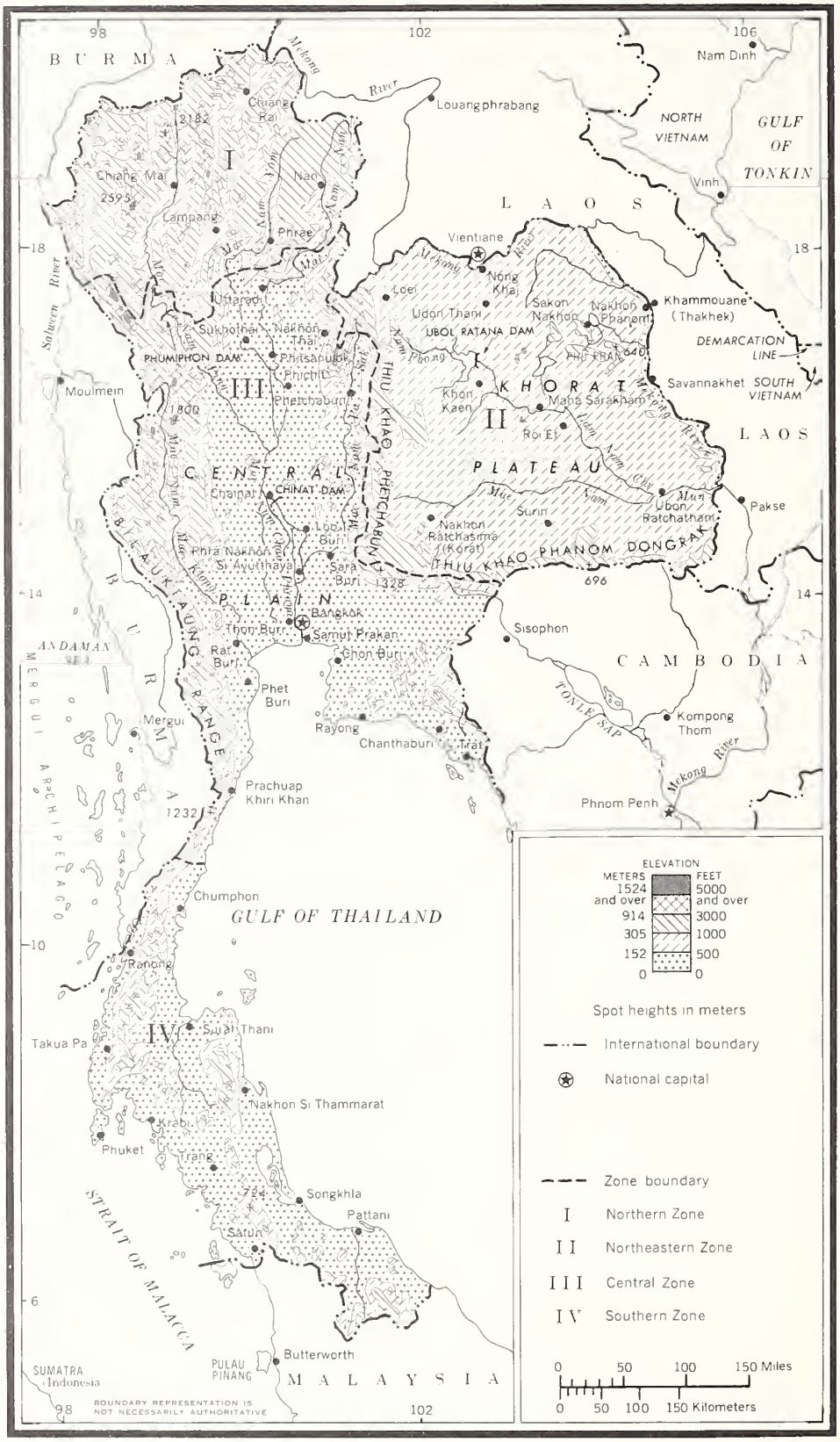
Thailand has a regionally varied terrain characterized by a vast, fertile river plain in the central part of the country, forested mountains in the north, a relatively dry plateau in the northeast, and mountain ridges and small coastal plains in the south (2).

The Central Plain (fig. 1) is Thailand's most productive region, as well as its most heavily populated area and its economic center. It is one of the world's major rice-producing areas. The Chao Phraya River, whose main channel flows through Bangkok to the Gulf of Thailand, is the dominant feature of the plain.

The river and its tributaries inundate the plain annually, providing the water necessary for rice cultivation and renewing the soil with valuable flood silt (23). The river is also the main and cheapest form of transportation for carrying rice to Bangkok (47), (23).

The plain has an extremely gentle gradient. At about 150 miles from the coast, the elevation is only 75 feet. Because the land is almost flat, the rivers overflow their banks after the start of the rainy season and cover large areas of the plain, beginning in May or June. In the northern two-thirds of the plain, high waters produce flash floods and torrential streamflows which can cause considerable damage to crops. However, in the lower part of the plain--the delta region--numerous dikes and klongs (canals) disperse the water (fig. 2) and afford considerable control of the flooding. The farmland is gradually transformed into a vast lake, with depths generally varying from 4 to 12 inches, but reaching up to 10 feet in places that can be planted only to deep water, or floating, rice.

The area that remains above the highest water level is very small. Villages are generally located along the flood embankments or on the few elevated sites. Farmhouses are built on stilts, which keeps them from being flooded (fig. 3). When the plain is flooded, boats are virtually the only means



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Figure 1.--Topography.



Figure 2.--Irrigation canal in Central Plain.

of transporting goods and moving about in the countryside, but the main highways between the major towns are open all year.

The water does not ordinarily recede until early November, with the onset of the dry season. Then the rivers fall to low levels and many small tributaries in the northern portion of the plain dry up.

East of the Central Plain, the Phetchabun Mountain Range separates the Chao Phraya Basin from the Mekong Basin. The Mekong River forms Thailand's boundary with Laos for about 450 miles in the east and northeast. Between the Phetchabun Range and the Mekong lies the Khorat Plateau, a broad, flat to gently rolling tableland with elevations of 500 to 1,000 feet in most places. Except in alluvial valleys, crop cultivation is hampered by floods in the rainy seasons and droughts the rest of the year.

Northern Thailand is taken up almost entirely by a group of high mountains, which form the beginning of the Himalayan foothills. These mountains are generally steep and covered with teak forests. Cultivated land occurs primarily in widely separated valleys.

Southwest of Bangkok, a narrow strip of land on the Malay Peninsula extends for some 450 miles to the border with Malaysia. On the eastern part of this panhandle is a narrow, fertile coastal plain; on the western part,



Figure 3.--Farmhouse in flooded area near Bangkok. Ricefields in background; grass used for forage in foreground.

along the Strait of Malacca, lies a narrower and discontinuous plain, where only scattered areas are suited to agricultural uses.

Climate

Thailand has a tropical climate which makes it possible to grow crops the year round, provided water is available. There is a wet and a dry season, determined primarily by the monsoons.

The season of rainfall starts in mid-March, but the heaviest precipitation occurs during the southwestern monsoon, mid-May through September. The dry season lasts from November to mid-March, except in peninsular Thailand which (with the sea on both sides) has rain during the entire year.

Frequent variations from the normal pattern of rainfall are: a late start; a prolonged break (sometimes with several rainless weeks, usually in August); an early termination; and an excessive concentration of rainfall in certain areas. Such variations, especially deficiency of rainfall, may result in serious damage to crops. For instance, a drought in July-August 1967 caused a 17-percent decline in paddy production over the previous year and a decline of 11 percent in the total value of farm output (37).

Annual precipitation averages 40-60 inches throughout the greater part of the country (fig. 4), but rises to 111 inches at Chanthaburi, southeast of Bangkok, and is much heavier in a few other places.

In the northeast, rainfall is less and not as dependable as in the rest of the country, and the rainwater percolates quickly through the underlying sandstone. Consequently, much of this region is semiarid for several months of the year.

January is usually the coolest month in Thailand, with temperatures averaging in the mid-70's, but occasionally falling below 55° F. In February, as the northeastern monsoon wanes, the temperature starts to rise, reaching a maximum in April or May, when the average is in the mid-80's. The maximum temperature seldom exceeds 95° F. High humidity adds to the discomfort in most places. After September, the temperature begins to decline noticeably.

On the Khorat Plateau, temperatures are often lower than in the rest of the country during the cool season, and sometimes higher in the warm months. In the peninsula, which has no cool season, temperatures vary little through the year.

Soils

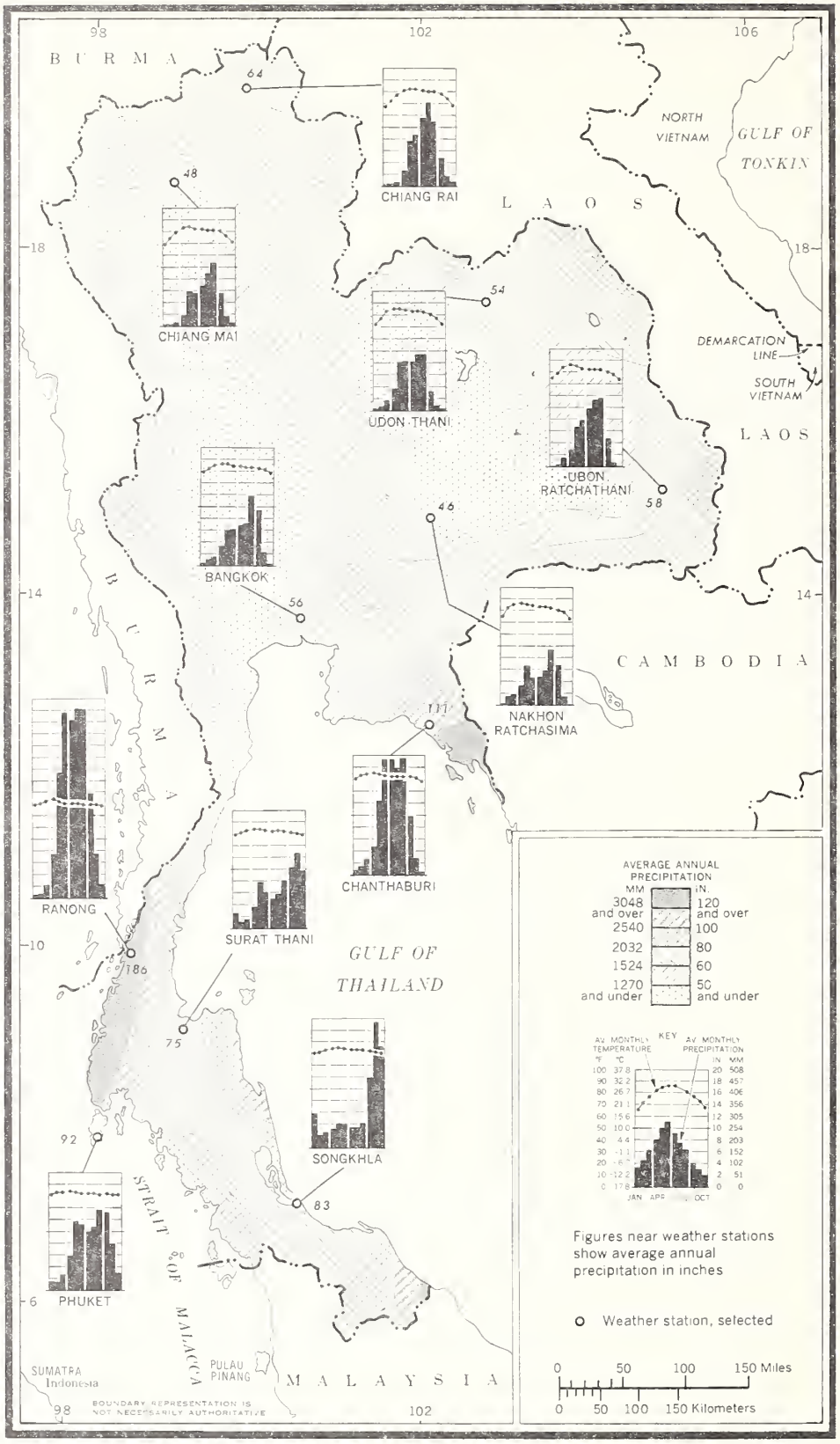
Red-Yellow Podzolic soils, either alone or in association with other soils, are the most extensive soils in Thailand. When alone, they are mostly in forest, although some are used for crops and orchards. They require heavy applications of lime and fertilizer for high yields.

On mountains and hills throughout the country, Red-Yellow Podzolic soils are associated with Reddish-Brown Lateritic soils. The soils of this association are mostly shallow or stony. Because of this characteristic and the steepness of the terrain on which they occur, these soils have little agricultural potential, although in places they are used for shifting cultivation.

Over much of the Khorat Plateau and in parts of the Central Plain, Red-Yellow Podzolic soils occur in association with Low-Humic Gley soils. Typically, the Low-Humic Gley soils are of moderate-to-low fertility. Good management practices, including application of lime and fertilizer and artificial drainage systems, can improve yields.

Alluvial soils are extensive on the Central Plain and along small coastal areas. They comprise poorly to moderately well-drained soils, and range in texture from sandy loam to heavy clay. Most of them are cultivated. In the vicinity of Bangkok and north of it, the Alluvial soils contain large quantities of sulfides; when drained, these soils become very strongly acid (pH 2.0-3.5) and unproductive. Good management would require careful control of the level of the water table (to prevent drying, which causes an extreme increase in acidity), and application of large quantities of lime and fertilizer.

Humic Gley and saline Alluvial soils occur south of Bangkok and along the coast. The Humic Gley respond to liming, fertilization, and drainage. The saline Alluvial soils contain large quantities of salt which preclude their



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Figure 4.--Rainfall and temperatures.

use for cultivated crops. Reclamation would require drainage, reduction of salt content by leaching, and protection from inundation by sea water.

LAND AND LABOR

Land Use

According to the census of agriculture, conducted by the National Statistical Office, nearly 10 million hectares, or about one-fifth of Thailand's total area, were cultivated in 1963 (table 1). 2/ Some 70 percent of the cultivated area was in rice and about 14 percent in tree crops such as rubber, coconuts, bananas, and other fruits.

Annual data by the Ministry of Agriculture indicate that the area under cultivation has expanded considerably over the past two decades; in 1965-67, the planted area alone (without the fallow land) averaged roughly 10 million hectares, some 3.6 million hectares more than in 1950-53 (30). Complete statistics for the last few years are not available, but the cultivated area has apparently continued to expand.

From 1950-53 to 1965-67, the area in field crops other than rice increased more than 4 1/2 times; that in tree crops about 1 1/2 times. During the same period, the area in rice increased 20 percent, but the share of riceland declined from 87 percent to 67 percent of the total cropland; the share of rice in the total area in annual crops declined from 94 percent to 76 percent (30).

Although large areas of virgin land can still be brought under cultivation in Thailand, the reserve of potentially productive land is diminishing because the growing population keeps expanding the area under cultivation. According to some rough estimates, the reserve of potential cropland may be exhausted by the mid-1980's. The area of cultivated land per person is expected to decline considerably before then.

The time may be approaching when Thailand will have to rely exclusively on higher productivity to expand farm output. The probable disappearance within the foreseeable future of the reserve of cultivable land is making it necessary for Thailand to promote balanced rural-urban development and to create more employment opportunities per unit of land in farming as well as new jobs in other economic activities.

In parts of the country, all land suited for farming is now being cropped, including marginal and reclaimed forest land, which should not have been used for agriculture (8). In the north and northeast, large tracts within an area of 2.2 million hectares officially classified as forest are cleared illegally and used for shifting cultivation.

A project for a systematic soil survey and land classification has been undertaken by the Ministry of National Development. As a result, some of the lands unsuited for cropping will be used for pasture and range development.

2/ Tables are grouped at the end of the report.

The optimum land resources base for Thailand is believed to be roughly 23 percent of the area in cropland and farm woodland, 51 percent in forest and grazing land, and 25 percent in nonagricultural uses, with the remaining 1 percent in water bodies (49).

Agricultural Zones

According to one of the most commonly accepted classifications, there are four main agricultural zones in Thailand (fig. 1). This division follows changwat (province) boundaries, but agricultural patterns, rainfall, physiography, and related factors, with minor exceptions, are similar within each grouping.

Central Zone

As defined here, the Central Zone comprises the entire Central Plain, some sparsely populated mountainous areas along the Burmese border, and the region east and southeast of Bangkok. All together, this zone takes up 36 percent of Thailand's total area and roughly 45 percent of its farmland.

The Central Zone, especially in the Chao Phraya Delta, is predominantly a rice-growing region. It accounts for an estimated 47 percent of the country's total area in rice and approximately 53 percent of rice output. In parts of the delta, rice takes up as much as 97 percent of the farmland and is virtually the only source of farm income.

On the outer perimeter of the Central Plain, mainly where the water supply is inadequate for rice, many upland cash crops, particularly corn, are grown in the rainy season. 3/ Nearly nine-tenths of the area in corn and roughly half the area in all upland crops is in the Central Zone. In the southeastern part, commercial cultivation of cassava and production of sugarcane are the main farming activities. Some rubber and fruits are also produced.

Output of rice in the Central Zone often exceeds farmers' consumption needs. Most of the rice exports, on which much of the country's economy depends, originate here. Because of the rice surplus and the cultivation of other cash crops, average farm incomes over most of the Central Zone are considerably higher than in the rest of the country. (See section on "Government Policy.")

Due to relatively favorable natural conditions and increasing use of modern inputs, the Central Zone, particularly its delta section, has the greatest potential in Thailand for increasing farm production, expanding commercialization of agriculture, developing the agribusiness sector, and helping expand other domestic industries by providing them with a fairly large and relatively prosperous market (12).

For social and political reasons, the Government is attempting to reduce regional income disparities by speeding up the economic development of the

3/ In Thailand, upland crops include all field crops other than rice. The term "upland rice" refers to rice which is exclusively rainfed.

poorer regions. The success of this effort and the overall development of the nation's economy depend largely on the continued growth of farm production in the Central Zone, since it is this region that must generate a large share of the necessary financial resources and provide most of the food needed to sustain the rapidly growing population (12). Therefore, Government efforts are also directed toward encouraging further development in the Central Zone.

Southern Zone

Most of peninsular Thailand is part of the southern agricultural zone. Ethnically and economically, the lower part of this region is more similar to neighboring Malaysia than to the rest of Thailand. Transportation links with Malaysia are more effective than those with the north. Most inhabitants are ethnic Malay, and Muslim by religion.

Rubber, produced primarily for export, is by far the principal crop of the Southern Zone and dominates its farm economy. Although the income from tin and fishing has been increasing and business activity in the towns has expanded (51), the economic welfare of the region largely depends on world rubber prices. These fell during most of the past decade and are not likely to regain permanently their previous high levels, mainly because of competition from synthetic rubber.

The Southern Zone also produces economically significant quantities of coconuts and fruits (mostly pineapples, bananas, and oranges), as well as cattle and water buffaloes. Rice, grown primarily on the eastern coast, is produced mainly for consumption on the farm. In most years, rice is brought into the Southern Zone from the Central Plain. Consequently, the price of rice in the south is considerably higher than in the rest of the country. (But prices are higher in Malaysia and some rice is smuggled into that country from Thailand.)

The combination of low rubber prices and relatively high rice prices is a source of economic hardship for a large sector of the southern population, especially near the border. There, most people derive their livelihood from rubber and are caught in a squeeze between low returns from rubber and high prices for rice--the staple food (51).

Were it not for the high cost of transportation to the urban markets, the Southern Zone would have a comparative advantage within Thailand for growing a wide range of fruits, including a number of indigenous ones not generally known outside Southeast Asia.

Northeastern Zone

Consisting mainly of the semiarid Khorat Plateau, the economically poor Northeastern Zone is separated from the rest of the country by mountain ranges as well as ethnic differences.

The Northeastern Zone takes up about one-third of Thailand's area and contains roughly the same share of its population. But in this unproductive region, the density of farming population per unit of cultivated land (2.2

persons per hectare) is 38 percent higher than in the country's most fertile areas (42).

In the northeast, with 87 percent of the households engaged in farming and 88 percent of the people living in farm households, agriculture is more prevalent than in any other region (42). Most of the farmers practice subsistence agriculture. Slash-and-burn cultivation is not uncommon. Average farm income is about 86 percent of the national average and less than 56 percent of the average in the most productive farm areas (41).

The region's poverty is due largely to adverse natural conditions. Soils are generally unfertile. Rainfall is low and erratic, and the supply of irrigation water inadequate. In parts of the plateau, where drainage is poor, the ground is swampy in the rainy season and floods cause extensive damage to crops. Improvement of water control is the most urgent need of northeastern agriculture (51), (47).

Rice, which takes up more than nine-tenths of the area planted to field crops, is not irrigated except in valley bottoms. Yields are low. Much of the land in rice would be better utilized if planted to drought-resistant crops (47). Corn, tobacco, cotton, vegetables, and mulberry bushes are cultivated on scattered patches of land. Nearly all Thailand's kenaf is grown in the northeast, primarily for export. Kenaf has become an important crop during the past decade, but annual output is very sensitive to world price levels.

The northeast has a comparative advantage in raising livestock and is Thailand's main livestock-breeding area. Most of the cattle and water buffaloes traded commercially in the country, as well as large numbers of the hogs sold on the Bangkok market, originate in this zone (4). Typically, each farmer owns a very small number of animals.

The development of an integrated crop-livestock farming system could contribute greatly to the region's agricultural development. However, such a system would necessitate, among other required changes, the conversion of marginal land now in rice to feed grain (47).

The distance of the northeast from Bangkok and--until the opening of the Friendship Highway a few years ago--the lack of adequate transportation links with the capital have slowed economic development of the region. The Thai Government, with help from the United States and to a lesser extent from other sources, is directing substantial efforts toward developing the economy of this area (38).

Northern Zone

Except for the area near Chiang Mai, where irrigation is available and farm incomes are among the highest in the country, the mountainous north is essentially a region of subsistence agriculture.

Farming land is scarce and concentrated in river valleys. Rice is the main crop. Tobacco, soybeans, peanuts, garlic, and some cotton are also grown.

On irrigated land, there has been a marked increase in the cultivation of cash crops which are generally planted as second crops after rice. Hogs are also a source of cash income.

Some farmers who cultivate small patches of lowland fields also practice shifting cultivation on hill or mountain slopes cleared by burning. The primitive Hill Tribes practice only shifting cultivation. They grow mostly upland rice and also opium poppies, although opium cultivation is illegal. These tribes inhabit the northernmost part of the region and consist of about a dozen groups totaling 220,000-300,000 people (52), (27).

Water Resources and Control

Over most of Thailand, lack of irrigation water during the dry season and inadequacy of supplemental irrigation during dry spells in the rainy season limit farm output and hinder crop diversification. Substantial crop losses also result each year from floods and poor drainage, but drought is by far the major cause of damage (47). Droughts and floods alone are estimated to reduce rice production in the delta region as much as 30 percent in 1 out of 3 years (12).

Cropland within officially designated irrigation projects totaled roughly 2 million hectares at the end of 1969. On part of this area, drainage, reclamation, and flood control works had either been completed or were underway. Two-thirds of the land in the irrigation projects is in the Chao Phraya Delta; the rest is scattered throughout the country. Apparently, some irrigation is also provided to extensive areas of cropland outside the irrigation projects, since the 1963 agricultural census put Thailand's total irrigated area at 3.6 million hectares.

Water for dry season irrigation is available only on a fraction of the irrigated land. At the beginning of 1968, the area that could be cropped year round totaled 452,000 hectares; however, work was in progress to make dry season irrigation possible on an additional 672,000 hectares (36).

In the Central Plain, virtually all the irrigation water is provided by the overflowing of the rivers in the Chao Phraya system. Dams and canals help disperse the water spilled over the land. This method provides a constant flow of water while the rivers are in flood, but is not designed to control the water level in the individual fields, and is not suitable for cultivation of the new high-yielding varieties of rice which require controlled irrigation.

Throughout most of the plain, the water supply continues to be too high at its maximum for any crop other than rice, and too low at its minimum for any crop to follow rice.

Control of water delivery to individual farms started in 1962 with the Ditches and Dikes Project. At the end of 1967, the area covered by ditches and dikes totaled 676,000 hectares. Work was in progress to extend it by an additional 327,000 hectares (36). Not all the land within the area of the Ditches and Dikes Project is under controlled irrigation, however, since a

number of farmers have failed to dig supplementary ditches to individual plots (12).

Several other projects for water development have been completed since the 1950's. Many more are being carried out or are at the planning stage. Expansion of irrigation is the major agricultural aim of the Second Development Plan (1967-71), which allocates about three-fifths of the expenditures for agriculture to the development of water resources (38). According to the plan, 2,400,000 hectares are to be in irrigation projects by the end of 1971 (36).

In addition to building dams, canals, and ditches, the Government has undertaken several related programs; they include teaching the farmers proper irrigation methods and providing credit for the acquisition of the inputs necessary for irrigated cultivation. Within the area of irrigation projects, water is made available to the farmers free of charge.

The northeast will benefit from the Mekong River Project, a multipurpose, long-term development program which affects Laos, Cambodia, and South Vietnam, as well as Thailand. The project is supported not only by these four riparian countries, but also by about a dozen other nations, including the United States, and by specialized U.N. agencies. The project calls for five dams on the Mekong and many others on its tributaries. One of the mainstream dams is expected to provide irrigation for some 800,000 hectares in northeastern Thailand, probably by the late 1980's. Several smaller projects that are part of the overall Mekong Basin development scheme have already been completed or are being planned.

Size of Farms

Though much larger than elsewhere in Southeast Asia, farms in Thailand average only 3.5 hectares (table 2). Average holdings are largest in the Central Plain (4.3 hectares) and smallest in the northern valleys (2.6 hectares). Most of the farms with 8 hectares or more are in rubber or coconut plantations, orchards, or banana gardens.

Thai farms are getting smaller, primarily because the cultivated land has not been expanding fast enough in relation to the growth of the farming population. In 1950, the average farm size was 4.5 hectares. In that year, 8 percent of all farms were 10 hectares or more, and only 15 percent had less than 1 hectare.

Since potentially cultivable land is becoming scarcer than in the past and since the number of people engaged in agriculture is projected to increase, the downward trend in average farm size may be expected to continue (28). In the more favored regions, the anticipated reduction in farm size may be offset, at least in part, by anticipated increases in productivity and more intensive cultivation practices.

Thai holdings are usually fragmented, often into widely scattered plots. It is not uncommon for a farm of 3 hectares to be divided into more than 10

parcels. In some areas, the size of each field has become so small that a buffalo with a plow cannot easily move around.

A Dutch-assisted pilot project is underway in the delta to study the economic impact of farm consolidation on utilization of irrigation water, use of farm machinery, and improvement of farm management (12), (47).

Farm consolidation is also being promoted through "block" agriculture. Under this project, which covers several thousand hectares, small adjoining ricefields are combined on a voluntary basis into units of up to 320 hectares to make better use of modern farming techniques. Yields have increased 60 to 70 percent. This promising type of land consolidation is expected to expand, although it has been held back by lack of enough managers (49).

Land Tenure

Problems of land tenure are not acute in Thailand. Tenancy and absentee ownership, with the accompanying disincentives to farm production, are not widespread. As mentioned, nearly 82 percent of the Thai farmers own all or part of the land they cultivate (table 3).

Until the turn of the century, when official titles were instituted, a farmer could secure up to 4 hectares of land by merely clearing and cultivating it. Today, farmers continue to obtain uncleared land in many parts of the country merely by complying with liberal--and often ignored--Government regulations (19).

This system of land tenure has held down tenancy over most of the country, has virtually eliminated farm unemployment (if not underemployment), and has kept Thailand nearly free of landless peasants. Nevertheless, prevailing patterns of landownership and the existing tenancy do create disincentives to farm investment and production.

Only about 22 percent of the farmland, most of it in the Central Plain, is held under a title deed (10). (At the present rate of progress, it would take perhaps 50 years to complete registration of all land.)

Another 22 percent of the cultivated land is held under titles that confer less than full ownership. Transfer of this type of land (other than by inheritance) is somewhat restricted. Banks do not accept such land as security for loans, although cooperatives in most cases provide short-term credit against it. Lack of clear title may also be a constraint on Government-sponsored land development schemes.

Holders of the remaining 56 percent of the farmland theoretically have no legal right to it; however, their claim to ownership is informally recognized by local authorities (10).

Ownership of agricultural land by aliens is restricted to 1.6 hectares (10 rai) and is possible only if a treaty between Thailand and the alien's country grants Thai citizens reciprocal landownership rights. Since no such

treaty has been signed with China, members of the Chinese minority who have not acquired Thai citizenship are prevented from owning land (19). Prospective foreign investors can arrange long-term leases of agricultural land.

Tenancy is virtually nonexistent in the northeast. It is most prevalent in the delta, where between one-third and one-half of the paddy fields are tenant operated. Paddy yields on tenant-operated land reportedly are only 83 percent of those on owner-operated farms (35).

Tenancy in the Central Plain is spreading, largely because of land speculation (generally by urban residents) and mortgage foreclosures (3), (12). A 1964 Government survey of certain areas in the plain found that 29 percent of the local paddy farmers were tenants with no land of their own, and 27 percent rented more land than they owned. Of the tenants with no land of their own, 19 percent had formerly owned land, but had been compelled to sell it (35).

Land speculation, partly related to the possibility of using the land for industrial development, affects primarily those areas along the main roads and canals which benefit from irrigation, drainage, and other improvements made by the Government. In those areas, the incidence of tenancy is apparently highest (12), (19), (47).

Short-term leases are prevalent. In the Central Plain, three-fourths of the tenants have 1-year oral leases and are not assured of contract renewal. Rents are generally paid in kind and average about one-half the crop. Cash rentals are somewhat lower. The tenant usually provides the draft animals and pays for all inputs (12).

The Government is helping some tenants to purchase the land they cultivate, by providing them with long-term financing through various cooperative schemes.

For many years, the Government has been promoting resettlement of landless farmers on newly opened land. Participation in land settlement schemes has also been opened to destitute persons from urban areas (2). In all, during the past three decades or so, approximately 432,000 families have received some form of assistance in opening up roughly 860,000 hectares.

Agricultural Labor Force

The number of people engaged in farming is continuing to increase in Thailand, although the share of the labor force in agriculture is declining, as shown by the following estimates of economically active people, 15 years and older (38):

Year	Total	Agriculture	Proportion of total
	Millions		Percent
1961	12.45	10.34	83.1
1966	14.55	11.62	79.9
1971 (projected)	16.76	12.68	75.7

Of those in agriculture, roughly 31 percent are farm operators; 66 percent, unpaid family workers; and 3 percent, wageworkers. Women, nearly 90 percent of them unpaid family workers, make up more than half the farm labor force. A number of people not classed as wageworkers also work on holdings other than their own. In more than one-third of the holdings, family members derive some income from working on somebody else's farm. Some 46 percent of the farm operators incur expenditures for hired labor (41).

Unemployment in agriculture is considered negligible. For the total labor force, it is about 1 percent nationwide, and 2-3 percent in urban and semiurban areas (38). Until now, Thailand has been able to provide employment for its expanding farm population by bringing under cultivation more of its unused arable land. In the past, a large share, if not most, of the surplus farm labor from densely settled areas found employment in farming areas where population pressure on the land was not as heavy (27). With the exhaustion of the reserve of cultivable land in sight and the employment-generating capacity of the nonfarm sector remaining limited, agricultural unemployment could become a problem in the future, especially if farm mechanization should reduce the requirement for agricultural manpower. 4/

As yet, the possibility of farm unemployment does not appear to be an unmanageable problem, as the increase in the farm labor force is slowing down, while opportunities for employment in urban occupations are in fact increasing. From 1961 to 1967, nonagricultural sectors accounted for 39 percent of the new jobs created during that period. The Second Development Plan anticipated that of the 2.2 million jobs to be generated during 1967-71, 52 percent would be in nonagricultural occupations (38). Data are not yet available, however, to confirm whether the plan's target has been achieved.

While farm unemployment is not a pressing problem, agricultural underemployment is widespread, and productivity is generally low. During the slack farm season, large numbers of farmers emigrate to the cities to supplement their incomes. This seasonal movement is largely unplanned (38), (47). Promotion of off-season employment in rural areas--through projects such as irrigation works for dry season cropping, development of cottage industries, and rural construction--is considered of special importance in Thailand since about three-fourths of Thai farmers are engaged primarily in rice production, a highly seasonal activity (38). As more water for dry season irrigation becomes available, double or multiple cropping (successively growing more than one crop in the same year) is expected to contribute significantly to smoothing out the peaks in farm labor requirements (47).

FARM PRACTICES AND INPUTS

Although many Thai farmers produce one or more commodities exclusively for the market, farming in Thailand is essentially of the near-subsistence type.

4/ Thus far, however, mechanization is limited in scope and consists primarily of tilling operations, done on a custom-hire basis (44). (See section on "Farm Machinery and Equipment.") There are indications that in some cases, this type of limited mechanization has in fact increased labor use, since most of the farmers who hire custom work use their released labor for other activities such as land clearing and irrigation improvement (47).

The relatively good production record of Thai agriculture--which has allowed for comparatively high levels of food consumption at home and has made possible large exports of food, feed, hard fiber, and rubber--has been achieved principally because of the availability of land and rather favorable natural conditions. Extensive methods of production continue to prevail in the country, and yields are generally low. Past production methods, which have often resulted in a type of depletive agriculture (12), (19), are no longer adequate for continued rapid growth and diversification.

A 1963 survey of farmers' incomes and expenditures (41) indicates the extent to which Thai farmers have introduced technological improvements. The percentage of farm operators incurring expenditures for certain types of inputs was: improved seed and plants, 22; breeding stock, 21; feed, 22; fertilizer, 22; tractor and animal hire, 16.

While more than one-fifth of Thai farmers make some use of modern methods of production, most farmers lack the means--as well as the knowledge--to take advantage of modern farming techniques. The Government is now taking the lead in the effort to increase farm productivity. It is injecting capital into agriculture, introducing new techniques, and strengthening or creating institutions to facilitate utilization of resources.

Crop Rotation and Cultivation Practices

Traditionally, Thai farmers have planted rice on the same field year after year, and have practiced very little rotation of other crops. This pattern has not been essentially altered by the introduction in recent years of crops such as corn, kenaf, and cassava, although corn is at times alternated with a leguminous crop, and fields normally in kenaf or cassava may be planted to a leguminous crop in one out of several years (24), (41).

In certain regions, corn and legumes are intercropped (that is, grown simultaneously in the same field). In the peninsula, where farmers grow mostly tree crops, they generally grow cassava, sugarcane, and pulses among the trees.

For lack of year-round water, double cropping is restricted to small areas, but is expected to increase (see section on "Water Resources and Control"). The pattern of double cropping prevailing in the north is rice, followed by tobacco or peanuts or by soybeans or garlic. Sometimes a second crop of rice is grown. In the rest of the country, a second crop of rice is grown over much of the double-cropped area, but some corn, sorghum, peanuts, soybeans, mung beans, sesame, watermelon, sweetpotatoes, and many other vegetables are also planted (12), (28).

In anticipation of expanding the double-cropped area, research programs have been initiated in the delta region to study the problems related to double cropping and to establish satisfactory patterns of irrigated cropping during the dry season without causing a decline in the yields of rice planted in the main season. Assistance is being provided by Australian experts under a Colombo Plan project. Research on double cropping is also underway in the northeast (47).

Over most of the country, the rotation system and cultivation practices have not been conducive to maintaining suitable levels of fertility, and impoverishment of the soil is continuing. Land erosion is a serious problem in the northeast (25), (49), and in other areas of slash-and-burn cultivation. Information on soil conservation is being distributed by the Government (38). The Accelerated Rural Development Program (see section on "Government Policy") pays considerable attention to soil conservation practices. This work has proven productive and has helped increase farm incomes (49).

Farm Machinery and Equipment

Most farmers work the land with simple tools and implements, such as wooden plows with an iron share, wooden harrows, hoes of various sizes, and sickles. Water buffaloes or, less frequently, cattle are employed for draft purposes and for threshing rice by trampling.

In 1963, fewer than 15 percent of the farms used mechanical power (table 4) Animal draft power is expected to remain the major source of motive power in Thai agriculture for the next several years, but land tillage by tractor is expanding considerably (44).

In parts of the Central Zone and in the south, most of the land in rice is plowed with tractors, generally by custom-service operators. Nearly all the fields in corn and most of those in cotton and sugarcane are plowed with tractors (44), also on a custom-hire basis. Some corn is planted mechanically, but harvesters would not be of much use as the crop is not uniform in size (51). Tractors are also commonly used in preparing the land for tobacco and kenaf (44).

The most common reason given by the farmers for hiring tractor services are timeliness and precision of mechanically performed farm operations, relief from backbreaking work, and ability to use their released labor for other economically profitable activities (44).

The anticipated expansion of double-cropped land will undoubtedly have an impact on farm technology in Thailand. Farmers planting two or as many as three crops a year will not be able to complete all planting and harvesting tasks without the aid of mechanical power.

The number of farm tractors in operation exceeds 20,000. Most of them are 50-70 hp. units. Approximately 90 percent of the total are owned by custom-service operators (44).

In addition to tractors, the more common mechanical equipment consists of water pumps and hand-operated sprayers. Cultivators, corn and peanut shellers, hay and grass mowers, and small portable engines are used less frequently. Most tractor owners also have one or two pieces of auxiliary equipment, generally a plow and less frequently a trailer (44).

All the larger farm machinery in use is imported. The four tractor assembly plants in the country have very limited capacity. Imports of certain types of equipment were:

Equipment	1961	1963	1966	1967	1968	1969
	Number					
Wheel tractors other than steam 1/	1,487	1,922	3,872	4,305	3,610	2,614
Crawler tractors other than steam 1/	152	327	705	1,393	1,494	1,017
Plows	3,755	12,158	26,378	31,250	20,807	4,676
Harrows	374	236	15,870	17,017	647	71
Hay and grass mowers	1,780	2,060	4,294	4,238	5,218	5,587

1/ Includes nonfarm tractors.

Crawler tractors are imported mainly from the United States; wheel tractors mostly from the United Kingdom and Japan. The Japanese share of the market has increased substantially in recent years. Most tractors imported from Japan are two-wheel units (44). Hay and grass mowers are mostly of U.S. and U.K. origin. Plows come primarily from South Africa and Australia.

The market for agricultural machinery in Thailand is currently estimated at $200 million per year and is expected to grow 15 to 20 percent in about 3 years. 5/

The Thai Government has taken a number of measures in favor of mechanization and it makes easy-term credit available to farmers' organizations for the purchase of agricultural machinery. Additional mechanical power may be necessary for the type of intensive agriculture (using multiple cropping) that is now being advocated by the Government. In the long run, indiscriminate and unplanned farm mechanization--while increasing the profits of the larger producers--could lead to large-scale displacement of farm labor that might find it impossible to be absorbed in other sectors of the economy.

Fertilizer

The use of chemical fertilizer in Thailand was virtually nil until World War II (8). As of 1963, only 9 percent of the farmers were applying any chemical fertilizer, according to the agricultural census. An additional 35 percent used only organic fertilizer (produced either commercially or on the farm). The rest used no fertilizer at all. Even today, a very large portion

5/ Detailed studies on the sales potential in Thailand of several categories of agricultural machinery, as well as fertilizer, pesticide, and other inputs, are available from the Developing Countries Trade Promotion Staff, U.S. Dept. of Commerce.

of Thailand's farmland receives no fertilizer of any kind, but application of chemical fertilizer is increasing rapidly (table 5). Between 60 and 70 percent of the fertilizer is used on rice (47); most of the rest on sugarcane, rubber, tobacco, fruits, vegetables, and corn (12).

The Government makes fertilizer available at cost and on easy-term credit to ricegrowers belonging to producers' organizations (Farmers Clubs), as well as to farmers in politically disturbed areas. In general, however, the price of fertilizer is considered to be too high in relation to the farm price of rice; this, of course, is a constraint on the expansion both of fertilizer use and rice production (12), (26).

Prospects for continued expansion of fertilizer use are favorable, though the ratio of return to cost is considerably lower than it could be and credit availability to both the trade and the producers remains inadequate (12). The increase in area under controlled irrigation is also expected to encourage expansion of fertilizer consumption.

The Central Zone absorbs more commercial fertilizer than all the other regions combined, but its predominance has declined with the spreading of fertilizer to other parts of the country (43).

Most of the fertilizer used in Thailand is imported. Major suppliers are Japan and, well behind it, West Germany. The United States has between 5 and 10 percent of the Thai import market. U.S. sales of fertilizer to Thailand consist primarily of ammonium phosphates.

Only one plant manufactures chemical fertilizer in Thailand. It has an annual capacity of 60,000 metric tons of ammonium sulfate and 30,000 tons of urea (43). The plant, which uses lignite for raw material, has not been able to withstand foreign competition successfully.

Consequently, imports of ammonium sulfate and urea fertilizers require prior Government approval and are virtually prohibited. Imports of certain other nitrogenous fertilizers--but not ammonium phosphates--also require prior Government approval, which, in fact, has not yet been given.

Organic fertilizers, such as oilcake, fishmeal, bonemeal, tankage, duck manure, and barnyard manure, are also produced and used.

Where moisture is sufficient or irrigation is available, legumes planted after the rice harvest may supplement the nitrogen content of the rice paddy. The use of green manure is very limited.

Plant Pest Control

Thailand's warm, moist climate is conducive to a high incidence of pest damage to crops, not only in the field but also in storage and the marketing process.

Application of pesticides in Thailand is more recent than that of chemical fertilizer. Local manufacture of pesticides is limited to some blending of

imported active ingredients. Import data indicate a substantial upward trend in the use of various pesticides:

Pesticide	Imports					
	1961	1963	1966	1967	1968	1969
	Metric tons					
Fungicides	6	132	404	501	838	535
Insecticides	1,604	4,125	6,371	10,387	10,700	12,997
Disinfectants	276	113	1,304	230	570	410
Herbicides	304	321	385	566	1,852	1,659
Rodenticides	8	16	22	23	37	33

The United States is the leading supplier of insecticides and is important in all other categories. West Germany leads in fungicides, herbicides, and rodenticides and is second in insecticides. Japan is gaining an increasingly larger share of the pesticide market. DDT is the largest selling item and most of it comes from the United States and Japan.

Cotton is the only crop on which pest control is carried out to any large extent by the farmers, but pests continue to cause extensive damage, and lack of adequate credit seriously hampers pest control efforts (49). Vegetables are relatively well protected from pests, but only a negligible amount of spraying and other insect control is done for other crops, such as rubber, corn, cassava, sugarcane, coconuts, kenaf, and rice (51). The ratio of pesticide cost to rice return is too low and the risk too high for widespread use.

The Government is taking an active interest in promoting pest control. Rice is the main focus of the Government's program, although attention is given to other crops. A Rice Protection Research Center has been set up, and several Rice Pest Suppression Centers have been established in various provinces. These suppression centers provide individual farmers with free help in the form of chemicals and spraying services for both rice and corn (12), (49), (51). In the 1968/69 crop year, pest control services were provided for some 1.2 million hectares of riceland. The Rice Department owns a small fleet of airplanes for aerial spraying (49).

Locusts and grasshoppers were not reported in Thailand until the mid-1950's. Since then, they have caused some damage to corn. The Government has been assisted by the Food and Agriculture Organization of the United Nations (FAO) in setting up and improving a program for locust and grasshopper control.

A beginning has been made, with some foreign help, toward the development of a program to preserve food and control insect pests of stored products by

radiation (13), as well as to introduce biologic control of rice stem borers through use of sterile male insects (49).

Improved Seed and Planting Material

A rice-breeding program, with the dual objective of increasing yields and ensuring uniform high quality for the rice export trade, was started on a small scale as far back as 1916 and has expanded since 1950, with U.S. technical aid. As a result, many new improved varieties have been developed. These are now used throughout the country and account for perhaps 30 to 40 percent of the area in rice, but some of these upgraded varieties are not much superior to the traditional ones (47).

Seed rice is multiplied and distributed by the Government in cooperation with farmers' seed committees, but many farmers do not buy new certified seed every year. They apparently prefer to grow their own seed once they have obtained an improved variety (32).

The new, high-yielding "miracle" varieties of rice, such as IR5, IR8, IR20, and IR22, have not been planted to any significant extent in Thailand. Traditionally, the country has had a surplus of generally high-quality rice. The need to expand production of rice is far less pressing in Thailand than in some other Asian countries with severe food shortages.

There is little or no domestic demand for the IR varieties, as they are unpalatable to the local taste; and it is unlikely that there will be a significant import demand for them. Furthermore, these new varieties are short-stemmed and require good water control, which is not generally available in Thailand. Institutional arrangements, particularly credit, are also inadequate for the rapid spread of the IR's.

Plant breeders in Thailand have been striving to backcross the IR varieties with some of the best local strains, such as Laungthong, to retain the high-yielding capacity of the former and the high quality of the latter. At the end of 1969, the Rice Department officially accepted three new varieties of rice resulting from backcrossing with IR8. The new varieties, RD1, RD2, and RD3, are high quality and have higher yields than IR8. RD1 and RD3 are white (non-glutinous) varieties. RD2 is glutinous (49). Research is being done to develop a new variety that can grow at different heights, depending on the water level (47).

Seed breeding and multiplication programs have also been underway for other crops, with assistance from the Rockefeller Foundation, which has also been helping in rice research. Various types of corn varieties, synthetics, composites, and hybrids have been tested. Work remains largely experimental, but 1,000 tons of Prabuddahabat No. 5 were distributed to the farmers for planting in the 1970/71 season. This variety is a high-yielding composite with a deep-orange flint kernel and is recommended countrywide (49). Sorghum varieties capable of yielding twice the amount of those currently used have also been developed.

Research is also being done on kenaf and oilseeds. But fruits and vegetables, whose improvement is necessary if their full potential for export is to be realized, have received very little attention (12), (49). A program to obtain higher yields of rubber by introducing improved varieties of clonal seeds and budwood has been in progress, with FAO assistance, since 1952.

CROPS

Thai agriculture consists primarily of growing crops for domestic consumption and export. Crops account for more than four-fifths of the total value of farm production and nearly the entire value of farm exports.

In Thailand's modern economic history, rice has been the principal crop, leading export, and mainstay of the economy. Its role in farm production remains preeminent (table 6), although new crops have been developed at an astonishing rate.

Rubber was first produced in large amounts in the late 1940's. Its output and exports have trended upward, even in years of falling prices.

Corn, and to a lesser degree, kenaf, cassava, and castor beans have become important export crops since the 1950's. Sugar has also become a surplus commodity. Edible oilseeds and dry legumes, grown mainly for subsistence, are beginning to be exported.

Production of cotton and high-quality tobacco does not meet domestic requirements. Sizable quantities of both are imported--largely from the United States. Output of certain types of tobacco, however, exceeds domestic needs. Thailand relies exclusively on imports for supplies of wheat, a declining share of which is imported as flour.

Other main crops, grown mostly for subsistence and varying in importance, include coconuts, bananas, and other fruits.

Rice and Other Grains

Rice

Thailand's staple food, rice is grown on nearly nine-tenths of the farms and takes up seven-tenths of the cultivated land. It is the only or most important source of livelihood for approximately half the country's total population (25), (47).

Rice now provides roughly one-fifth of the value of Thailand's total exports. Accounting for two-fifths of total value of farm production, rice generates one-tenth of GDP. These figures, however, underestimate the real share of rice since the Government has kept the farm price artifically low, primarily through export taxes. By regulating the price of rice, the Government can affect the cost of living (12), since this price has a major impact on consumer prices and, indirectly, on nonagricultural wages.

The Central Zone leads in both area and production of rice, which is grown throughout the country (fig. 5).

As table 7 shows, estimates of rice area and production vary. National Statistical Office data for the years since 1966 are considered more reliable than those from other sources. Although an accurate analysis of trends is virtually impossible from available data, it seems that the expansion in rice production of the past two decades has been brought about by increases in both area and yields. The increase in yields apparently is a reversal of previous years' trends, but rice yields in Thailand continue to be among the lowest in Southeast Asia. According to some experts, the area in rice has about reached its limit (47). Further increases in productivity will be necessary if output is to keep expanding.

Thailand supplies about one-sixth of total rice in world trade. Some 80 percent of its exports go to other Asian countries (table 8). For some years in the 1960's, Thailand overtook Burma as the leading world exporter of rice. In 1967, however, Thailand again became second, but this time following the United States.

About one-fourth of the Thai foreign sales of rice are made under government-to-government agreements. Lately these agreements have been entered into with India, Indonesia, South Vietnam, Japan (which has bought glutinous rice for its own consumption and other types of rice for shipment to Indonesia as aid to that country), Ceylon, Malaysia, Mauritius, and Brunei.

Exports under government-to-government contracts are handled in Thailand by private exporters, but if the trade is unable to supply the entire amount committed, the Government's Public Warehouse Organization helps fulfill the contract from the stocks it has available.

World trade in rice has been unstable in the past few years and at lower levels than in the mid-1960's, partly because of the successful drive toward self-sufficiency in many of the formerly deficit countries. Exports from some developed countries are being increasingly subsidized and the share of concessional sales in total rice transactions has increased (14).

To stimulate its foreign sales, Thailand recently eliminated certain taxes on most exports of rice.

Through most of 1970, all exports of rice and rice preparations were subject to a so-called rice premium, the rate of which varied from time to time and with the type and grade of the product. On the average, during the 1960's the Government received roughly one-third of the export price, the farmer less than one-half. (A decade ago, taxes on rice accounted for about 14 percent of the Government's revenue, but their contribution was down to 7 percent in the late 1960's.)

Between the fall of 1970 and the spring of 1971, the rice premium on most exports was abolished, but it was retained on exports of nonglutinous milled and brown rice with no more than 5-percent brokens. Currently, the tax is $36.05 per metric ton on rice with less than 5-percent brokens and $32.45 on rice with 5-percent brokens.

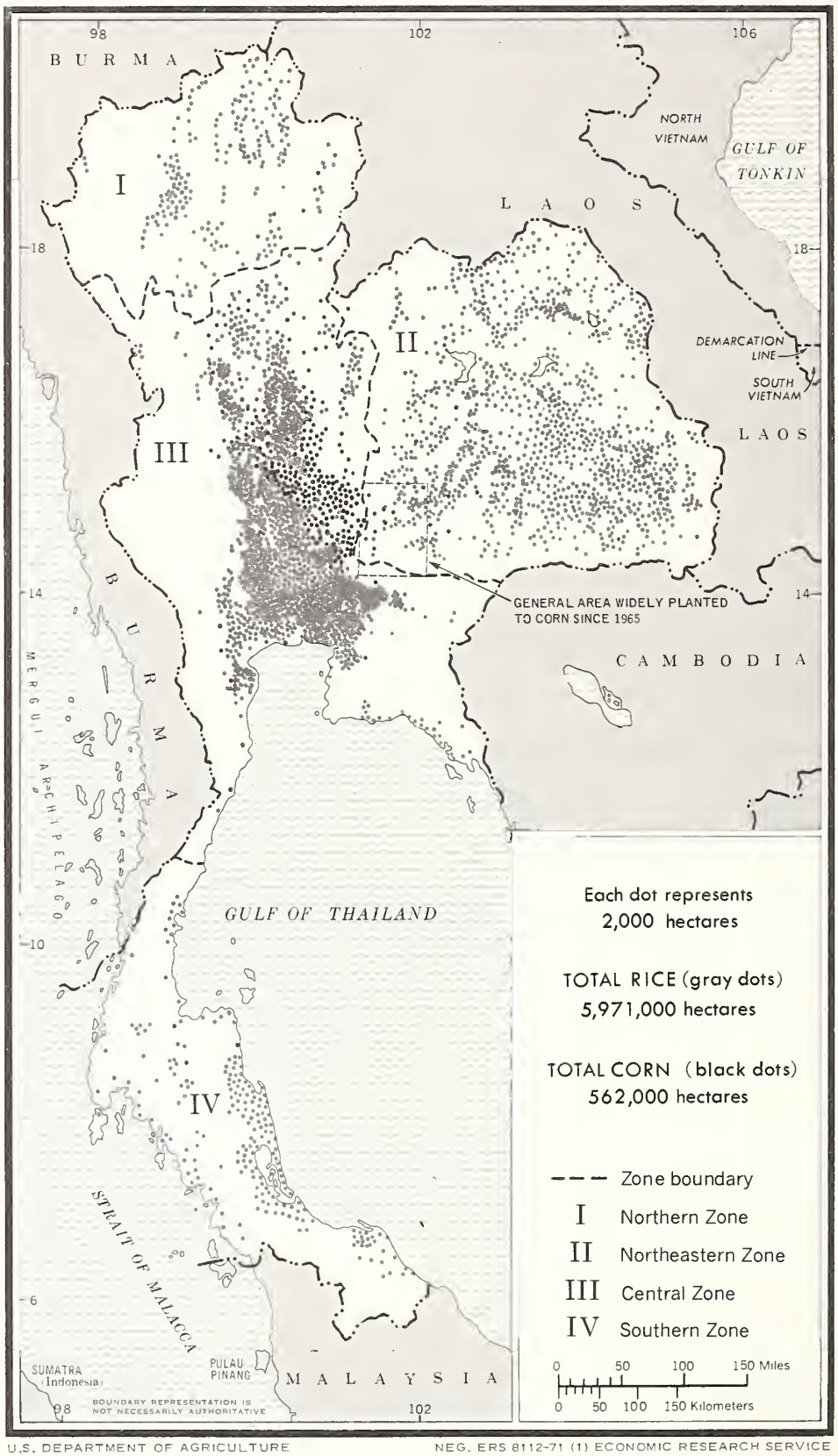


Figure 5.--Distribution of harvested areas in rice and corn, 1965.

The rice on which the premium continues to be levied accounts for roughly one-fifth of total quantities exported and approximately one-fourth of their value.

All rice exports remain subject to an ad valorem tax, varying between 3.75 and 5.40 percent, and to a lower municipal export tax.

Also to stimulate exports, the Government has begun making long-term credit sales of rice to foreign countries and is considering barter arrangements to exchange rice for fertilizer, pesticide, and other agricultural inputs (49).

Other ways in which the Government intervenes in the production and marketing of rice include: setting a minimum export price, licensing exporters, setting temporary export quotas, determining a minimum quaranteed producer price, and subsidizing certain inputs. In most seasons, however, the minimum guaranteed producer price has been lower than the price paid by the market.

Farmers generally sell their rice surplus unmilled either to local dealers or itinerant buyers or directly to the mills (12). The farmers retain, as a very rough average, about two-fifths of their production and sell the rest. About one-third of the amount retained by the farmer is used for seed and feed (25).

The bulk of the marketed production is sold soon after harvest, when prices are very low. Farm storage facilities, which consist largely of handwoven baskets, are mostly unsatisfactory. Storage facilities of the commercial dealers are generally adequate. The farmers' associations need silos, however, if they wish to obtain better marketing terms for their members by holding and storing rice. The Government anticipates that it will have to stockpile large quantities of rice to implement the present system of minimum guaranteed farm prices. In mid-1970, a plan was under consideration for the construction of 79 silos throughout the country (49).

Many hundreds of varieties of rice are grown in Thailand. They are generally classed according to the time they require to mature after transplanting. Early varieties ripen in 2-1/2 to 3 months and medium varieties in 3-4 months. Varieties taking 4-5 months or more account for the largest share of the harvest. In general, the longer the ripening period, the better the quality of the rice. By growing a little of each type, a farmer gains some insurance against the vagaries of annual rainfall, and achieves better distribution of planting and harvesting labor.

Both glutinous and nonglutinous rice are planted, the latter on about two-thirds of the total rice area. Glutinous rice is grown mainly in the Northern and Northeastern Zones.

As already noted, Thailand has not rushed into adoption of the IR varieties which are not well accepted at home and not suited for the export market. But it is developing new varieties which are readily marketable, as well as high yielding. The unofficial price of the seed of some of these varieties is very high, indicating there is already some demand for them (47).

Most of the rice in Thailand consists of wet, or lowland, rice and is grown by transplanting (fig. 6). The broadcasting method uses less labor but more



Figure 6.--Rice seedlings being pulled from nursery for transplanting in paddy field. Palmyra or sugar palms in background.

seed and results in lower yields per unit of land. In the north, the Hill Tribes plant rice by digging holes in the ground with a pointed stick, dropping a few seeds in the hole, and using their feet to cover the seeds with dirt.

Broadcast paddy fields are more likely to suffer from weeds than transplanted paddies are. One of the most serious weeds is Ipomoea. Fusarium kernel rot is the most common disease; others include orange-yellow leaf, blast, brown spot, stem rot, collar rot, and false smut. Rats, crabs, and birds also cause crop losses, but insects are more damaging. Among these are the stem borer, rice stem gall midge, leafhopper, mealybug, and armyworm.

In the Central Zone, the planting season usually starts in May and extends through August; harvesting starts in October or November with the onset of the dry season and continues until January or February. The main harvesting months are November-January. In the Northern and Northeastern Zones, planting usually starts in June. In the Southern Zone, where rainfall is more evenly distributed, planting operations extend over July-December and harvesting over January-April. Where two crops of rice are planted within a year, the second crop is generally grown between January and early July(12) and harvested in August-September (49).

Corn

Aside from rice, corn is the only important grain grown in Thailand. In recent years, it has gained a significant position in the nation's economy and now accounts for more than one-tenth of total export earnings. Thailand has become one of the world's largest exporters of corn and its world market share is about 5 percent.

Average annual production, almost entirely for export, has increased from 54,000 metric tons in the early 1950's to more than 2 million tons (table 9). This spectacular increase--often cited as one of agriculture's most striking success stories in the post-World War II period--was brought about by the farmers themselves in response to market stimuli and with virtually no direct assistance from the Government. However, construction of new roads linking the producing areas with the market gave impetus to the cultivation of corn (50).

At present, nearly the entire crop is flint corn, consisting of the Guatemala open-pollinated variety. Fertilizer is applied only to an estimated 5 percent of the corn area (8), although corn cultivation causes rapid depletion of soil fertility unless corrective measures are taken. Virtually no hybrid corn is grown, but farmers have begun planting a high-yielding composite variety. (See section on "Improved Seed and Planting Material.")

Most of Thailand's corn exports go to Japan. Sales to that country declined in the late 1960's (table 10), but have picked up and appear to be headed for record levels. Agreements covering price and quantities of corn for Japan are negotiated annually between the Thai Board of Trade and the Japanese Feed Importers Association. With some exceptions, price is based on the price in the Chicago futures market for U.S. No. 2 yellow corn. Until recently, sales to Japan generally fell below agreed maximum quantities, because Thai exporters, after supplying the minimum quantities called for in the annual agreement, sold to more profitable markets in the Far East.

In the 1970/71 season, with Thailand striving to reduce its trade deficit with Japan, the target of Thai corn sales to Japan was set at 720,000 metric tons. The Japanese agreed to purchase whatever quantities of corn were offered by the Thai, subject to certain specified conditions (49). Actual shipments amounted to 845,000 tons. Under the 1971/72 agreement, the target has been set at 1 million tons, with a minimum of 880,000 tons and a maximum of 1,020,000 tons.

A similar pricing and marketing arrangement was agreed on with Taiwan for the first time in 1970. Under that arrangement, Taiwan agreed to buy 320,000 metric tons of Thai corn in the 1970/71 season and will purchase 400,000 tons in 1971/72. Taiwan began importing Thai corn in 1960 and is now the second largest importer.

The small but increasing share of corn retained within Thailand is used mostly for feed, especially for poultry. Corn is grown mainly in the Central Zone and adjacent areas in the Northeastern Zone (fig. 5). Usually, the crop is planted in March-April and harvested in July-August. Sometimes a second crop is planted, generally in July-September, but there is risk of insufficient rain. After harvesting, corn ears are generally spread on a raised platform to dry in the sun and are shelled a few days later, sometimes on a custom-hire basis, by small cylinder-type shellers mounted on oxcarts or tractors. The first crop is sometimes difficult to dry because it is harvested in the rainy season. A share of the shelled corn is shipped through country dealers to Bangkok for storage and export. A modern complex of corn storage and drying facilities has been built near Ayutthaya and in other locations throughout the corn-growing area, but the operation of these facilities has run into financial difficulties. Few farms have other than temporary storage capacity for corn.

Corn rust and leaf spot are the major diseases. Mildew has been noted in the past few years but not on a large scale (49). The European corn borer is the major insect pest, but the Guatemala-type corn grown in Thailand is very hard, horny, and resistant to insect attack. Occasionally the crop has been damaged by locusts.

Other Grains

Sorghum production averaged some 73,000 metric tons in 1968-70 and is expected to be 95,000 tons in 1971. Nearly all of it is exported, primarily to Japan. Research is being conducted to adapt sorghum cultivation to local conditions. The crop could become an important export, but not in the near future.

Wheat cultivation was attempted experimentally in the 1960's, but current production, if any, is negligible, and wheat and wheat flour are relatively important imports. Until the mid-1960's, when modern milling facilities became available, imports consisted almost exclusively of wheat flour (table 11). Australia is the major supplier of both wheat and flour, but the United States has gained a considerable share of the wheat market (see section on "U.S. Trade with Thailand").

Rubber

Thailand ranks fourth among countries exporting natural rubber, accounting for about 7 percent of the world total. Rubber was the first crop to make a

substantial inroad into the traditional dominance of rice in Thai agriculture (9), and it is now the nation's second most valuable export. Expansion of the planted area was stimulated by the high demand for rubber during World War II and the Korean conflict.

Production and exports of Thai rubber have expanded considerably over the past several years (table 12), but export earnings from the crop have fluctuated widely, with a significant downward trend (table 22).

International rubber prices fell during most of the 1960's, recovered somewhat in the last 2 years of the decade, and declined again in 1970. The decline in prices was caused primarily by competition from synthetic rubber. The temporary upturn in the late 1960's resulted in large part from heavy buying of natural rubber by Mainland China. As purchases by China fell, so did international prices. Longrun prospects for high prices of natural rubber are not favorable. World production of polyisoprene--a true synthetic, since it has the same chemical structure as natural rubber--began on a large scale in the mid-1960's. Anticipated expansion in the output of this true synthetic will undoubtedly restrain increases in the price of natural rubber (47).

In 1969, rubber accounted for 19 percent of the total value of Thai exports, compared with 30 percent in 1960 and 11 percent in 1967 when--with rubber prices at their lowest for at least two decades--rubber ranked third after rice and tin as an earner of foreign exchange.

The sustained expansion in rubber production is due partly to slightly improved yields and partly to a considerable increase in the tappable area. Since rubber is a perennial tree crop, response to declining prices is slow. Low prices do not necessarily discourage tapping, particularly in Thailand, where most producers have limited or no alternate sources of income.

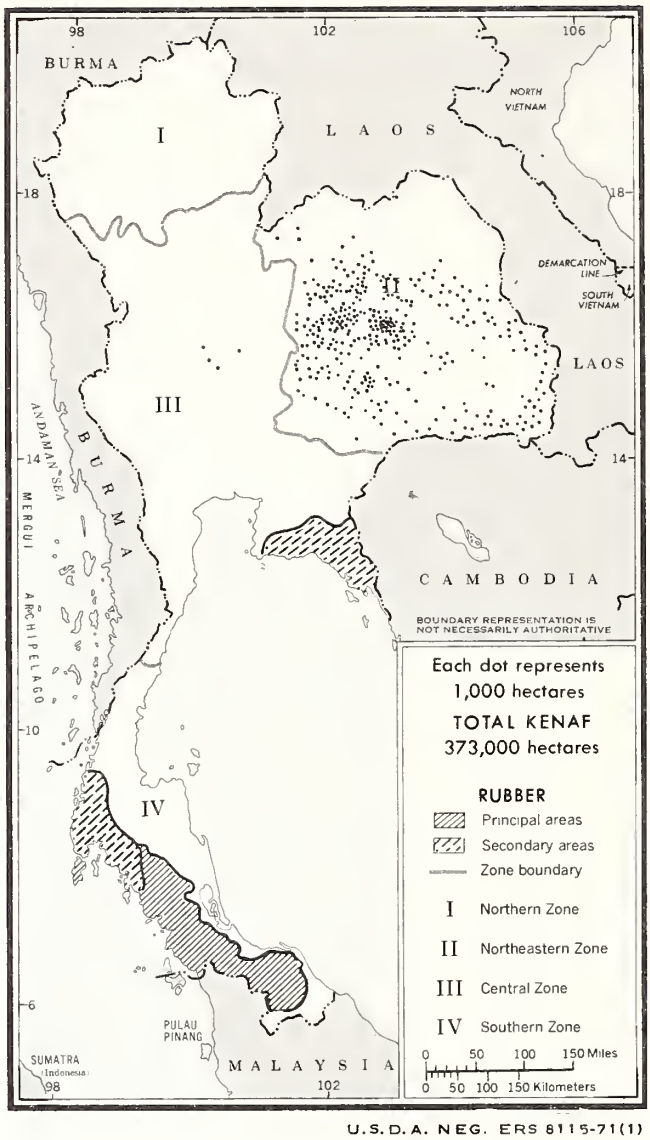
Rubber production is concentrated in peninsular Thailand. A small part comes from three southeastern provinces (fig. 7). Rubber producers number some 270,000 and hired laborers total perhaps 50,000-60,000 (9).

Most producers are small farmers. Almost nine-tenths of the area in rubber is in holdings having less than 22 hectares each. Some large plantations are located in the southeastern provinces.

Only a small share of the rubber is retained in Thailand, mainly for the production of tires, tubes, and shoe soles. Two American firms are engaged in tire manufacturing in Thailand. Japanese interests are also represented.

Japan is the principal market for Thailand's natural rubber, having replaced the United States as the main outlet. Other important markets are the United Kingdom, Malaysia (for transshipment to final markets), and West Germany.

In the international market, Thai rubber is faced with strong competition not only from synthetic rubber but also from more efficient producers of natural rubber. The prospect that Thailand will be able to meet the competitive challenge is uncertain, despite the Government's efforts to improve the quality and marketing of natural rubber.



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Figure 7.--Distribution of harvested area in kenaf, 1965, and regions planted with rubber trees.

Until 1951, Thai rubber trees were exclusively native, unselected varieties. Since then, Malayan varieties which yield almost twice as much as native trees have been introduced. Meaningful increases in production can only be brought about by replanting existing areas with high-yielding varieties. For this purpose, the Government has established a Replanting Aid Fund Scheme which is financed out of a levy on rubber exports. Production from replanted areas is just starting. In 1968, it was a mere 318 metric tons. In about 20 years, the replanting scheme could more than double production of natural rubber, but it remains to be seen whether the program will be successfully carried out. The short-term outlook is for no significant change in Thai rubber output (49). Some consideration has been given to whether the Government should encourage a switch from rubber to oil palm cultivation.



Figure 8.--Trainee at Rubber Research Center in the south taps virgin bark of tree of Malayan variety.

Specialized agencies of the United Nations and other foreign sources have supplied financial assistance and personnel to provide training in rubber production (fig. 8), processing, and marketing (51).

Less than one-tenth of total Thai rubber output is grade I standard. Generally each producer or small plantation owner uses simple processes to coagulate the latex he collects and then rolls it into sheets; he sells the sheets unsmoked or only partly smoked and air-dried. This preparation by crude methods using homemade equipment does not always remove all the impurities. The price of Thai rubber on world markets is generally lower than that of rubber from other countries because of its lower and irregular quality. However, an increasing amount of Thai latex is being processed into blocks rather than sheets. This not only improves quality, but also reduces costs. In 1968, there were six factories in Thailand producing block rubber (6).

Oil-Bearing Crops

Fresh coconuts and lard are the major sources of fat in the Thai diet (12). In normal years, the country has been about self-sufficient in vegetable oil production, a net exporter of oil-bearing crops, and a modest importer of animal

fats. 6/ As far as is known, there are no official data or reliable records of amounts of oil-bearing crops actually pressed into oil within Thailand. Total annual capacity of the vegetable oil industry was less than 49,000 tons at the end of 1967. Vegetable oils have reportedly risen in popularity since the late 1960's and imports of oil may increase. However, the oil equivalent of oil-bearing crops now exported is much higher than the amount of oil imported.

According to one study, 1965 domestic consumption of edible vegetable oil was about 35,000 metric tons. The more important types of oil were peanuts (9,900 tons), coconuts (9,800), rice bran (5,100), kapok seed (5,000), and cottonseed (3,400) (12).

Coconuts

Thailand ranks fifth among world coconut producers, but the country's role in world trade of coconuts and coconut products is negligible, as about nine-tenths of production is consumed fresh domestically.

Thailand is a member of the Asian Coconut Community, but thus far its membership has had little if any effect on this sector of Thai agriculture (47).

From official data, it seems that the coconut area has increased markedly while production has expanded by relatively modest amounts, as shown below:

Year	Area	Production
	1,000 hectares	1,000 metric tons
Average:		
1951-55	107	915
1956-60	140	1,144
1961-65	219	1,114
1966	247	1,069
1967	272	1,121
1968	272	1,208
1969	272	1,265
1970	272	1,328

Production has not kept pace with the increase in area partly because many of the trees are old and unproductive and partly because large numbers of newly planted trees are just beginning to bear. In 1967, there were an estimated 42.3 million coconut palms in Thailand, 22.3 million of which were productive--48 percent of the total. In 1951-55, nearly three-fourths of the coconut palms were bearing. New trees require 6-8 years before they begin to produce, and reach full maturity in about 15 years. They retain full vigor for 60 years; under good care, many bear for 100 years. Some trees bear year-round but the bulk of the harvest is from October through January.

6/ Australia is the chief supplier of fats, especially tallow. Lower prices and freight rates account for Australia's leadership in the tallow market (49).

Coconut trees are planted throughout the country, often in gardens with other trees, and usually in small holdings. However, production is concentrated in the peninsula, where coconuts are also a cash crop, and in the coastal areas of the Central Zone.

Various species of palm weevils and the scarab beetle (Oryctes rhinoceros), are serious pests. Larvae of moths and butterflies, as well as rats and squirrels, also do considerable damage.

Commercial production of copra--dried coconut--is perhaps about 20,000 metric tons annually (or some 115,000 tons of coconut equivalent), and has remained virtually unchanged since World War II. In most years, the copra oil produced domestically does not meet the modest local demand, and small amounts are imported (from as little as 47 tons to no more than 1,400 tons annually). Nearly all copra cake and meal are exported, averaging almost 8,400 tons per year in 1964-68.

Copra is produced mainly in the south, especially on Ko Samui, an offshore island in the Gulf of Thailand. It is usually produced by sun-drying, although some is prepared in simple drying furnaces. Coir fiber, extracted from the outer husk of the coconut, is not extensively utilized in Thailand (51).

Oilseeds

Area, production, and exports of oilseeds are shown in table 13. Foreign trade in oil is not large. The first relatively significant imports of vegetable oil occurred in 1969 with the purchase of some 3,000 tons of soybean oil, about half of it from Israel. If local processing facilities are not expanded, imports of vegetable oil may become relatively important (49). Exports of oil are negligible except for shipments of peanut oil which in most years reach nearly 1,000 tons but only 244 tons in 1969. Exports of oil cake and meal (not counting coconut byproducts) average less than 20,000 metric tons annually and consist mostly of peanut cake and meal. Japan is the major outlet for Thai oilseed exports.

About two-thirds of the peanuts retained in the country are eaten boiled, rather than being pressed into oil. Dry roasting is not common. A substantial part of the peanut oil consumed in the country is used for illumination.

Nearly two-fifths of the peanut area is in the Central Zone, which accounts for an approximately equal share of production. Peanuts are often planted between rows of corn, cotton, or young trees during the wet season. In the northern valleys and other areas where irrigation water is available, they are planted in ricefields after the rice harvest. Generally, the farmer sells his peanuts unshelled and partly dried soon after harvest, because of lack of storage. Common peanut diseases are root rot and leaf spot; leaf miner is the major insect pest.

Soybeans are not generally pressed into oil in Thailand, but are consumed as legumes. They are generally planted as a second crop in paddy fields after the rice harvest. Rust and a seed-boring caterpillar (of the blister beetle) are the most serious pests.

About three-fifths of the soybean crop is grown in the Central Zone and most of the rest in the Northern Zone. Output is clearly at much higher levels than in the early 1960's, but because of conflicting data, it is virtually impossible to determine actual amounts of production. Future increases in soybean production may come from the northeast as a result of the crop diversification program there (49). Development of soybean production and improvement of seed is taking place in the north, and attention is being given to varieties that can be readily marketed in Japan. (49).

Sesame seed is grown mainly in the Central and Northeastern Zones. Almost all the oil from it is produced and used on the farm, mainly for cooking but also for lighting.

Thailand is the world's second largest exporter of castor beans, after Mainland China, but ranks seventh as a producer. Production is primarily for export as unprocessed beans. Almost two-thirds of the crop is grown in the Central Zone and a little more than one-third in the Northeastern Zone. The most widely planted variety is a large, spreading, low-yielding perennial. Castor beans are grown primarily in small plots and receive little care. They are attacked by leafhoppers and caterpillars.

Cottonseed and kapok seed are, of course, byproducts of cotton and kapok fiber. Wasted until not too many years ago, these seeds are now utilized--cottonseed primarily for export, kapok seed for domestic production of oil.

Fiber Crops

Kenaf

Production of kenaf, which is used primarily for the manufacture of gunnybags and as a substitute for jute, also started in Thailand after World War II, mostly through private initiative (12).

In the mid-1960's, the big stimulus to the increase in kenaf production was provided by large exports to India. Before then, India had supplemented its jute production with imports from Pakistan, but during its 1965 armed conflict with Pakistan, and for a period after that, India made large purchases of Thai kenaf. In 1967-69, however, such imports averaged only 41,000 tons per year, compared with 244,000 tons in 1966. Exports to Thailand's other major markets--Japan and West European countries--have also dropped.

Output of kenaf is strongly affected by foreign demand and prices. After spectacular growth, production and exports (as mentioned) began declining in 1967. Output has recovered in part, but amounts exported have continued to drop (table 14). Production in 1968 was 35 percent of that in 1967. The great slump in both area and production was due mainly to the big loss suffered by growers in the previous year, when farm prices were only 50 percent to 75 percent of production costs (51).

Local and export prices in 1969 were better than in the previous 2 years. In 1969, the value of kenaf exports was higher than in 1968 (table 22), despite a lower volume of sales. However, long-term prospects for kenaf are not

favorable. Domestic consumption has also begun to decline. In 1969, manufacturing of gunnybags--locally, the major use of kenaf--was down to 44.9 million units, 10 million less than in the previous 2 years. (About two-thirds of gunnybag production is exported. Indonesia, Singapore, and Italy were the principal buyers in 1969.)

Continuous research is being conducted in Thailand to improve quality of kenaf--an essential objective in view of the dwindling export market. The kenaf sector could be revitalized if new uses for the crop are found through research. For instance, work in the U.S. Department of Agriculture (USDA) indicates that kenaf can be used as an alternative raw material for papermaking.

Virtually all Thai kenaf is grown in the northeast (fig. 7), where it is the principal upland crop. Most kenaf is planted in small plots on newly opened land; when the soil loses its fertility, the land is left fallow for 2-3 years and then cultivated again. Plants, generally sown in May-June, are harvested in October-February.

After being cut, the stalks are submerged in water until the fiber can be easily removed and before it is weakened. Separation of the fiber from the stalk takes much hand labor.

Cotton

Thailand, with one of Asia's highest per capita consumptions of textiles, is a relatively large importer of cotton and cotton goods.

In 1968, cotton goods accounted for more than 80 percent of total Thai textile output (12). More mills for manmade fiber have been constructed since then and use of synthetic fiber has reportedly increased, but the use of cotton has also expanded (49). Mill use of cotton is currently estimated at some 50,000 tons per year.

Concerned over the size of the import bill for both raw cotton and cotton manufactures, the Government has been striving to achieve self-sufficiency in raw cotton (50). However, the goal is apparently several years away, and there is doubt that it may be attainable.

Although an intensified cotton promotion program, aided by France and the United Kingdom under the Colombo Plan, was rather successful in expanding area and production during most of the 1960's (table 15), cotton cultivation received a severe setback in the late 1960's and early 1970's.

After the 1968/69 crop was hit hard by both drought and insect damage, the area planted in the 1969/70 season declined by about one-third--to 104,000 hectares. This drastically reduced area again suffered from drought, disease, and insect infestation, which reportedly destroyed the crop in nearly 40 percent of the fields. According to the Office of the U.S. Agricultural Attache in Bangkok, further declines in both area and production occurred in 1970/71 (49).

Although the 1969/70 crop was much smaller than usual, domestic wholesale prices of unginned cotton (farm price quotations are not available) were lower than a year earlier--3.70 baht per kilogram, compared with 4.05 baht after the

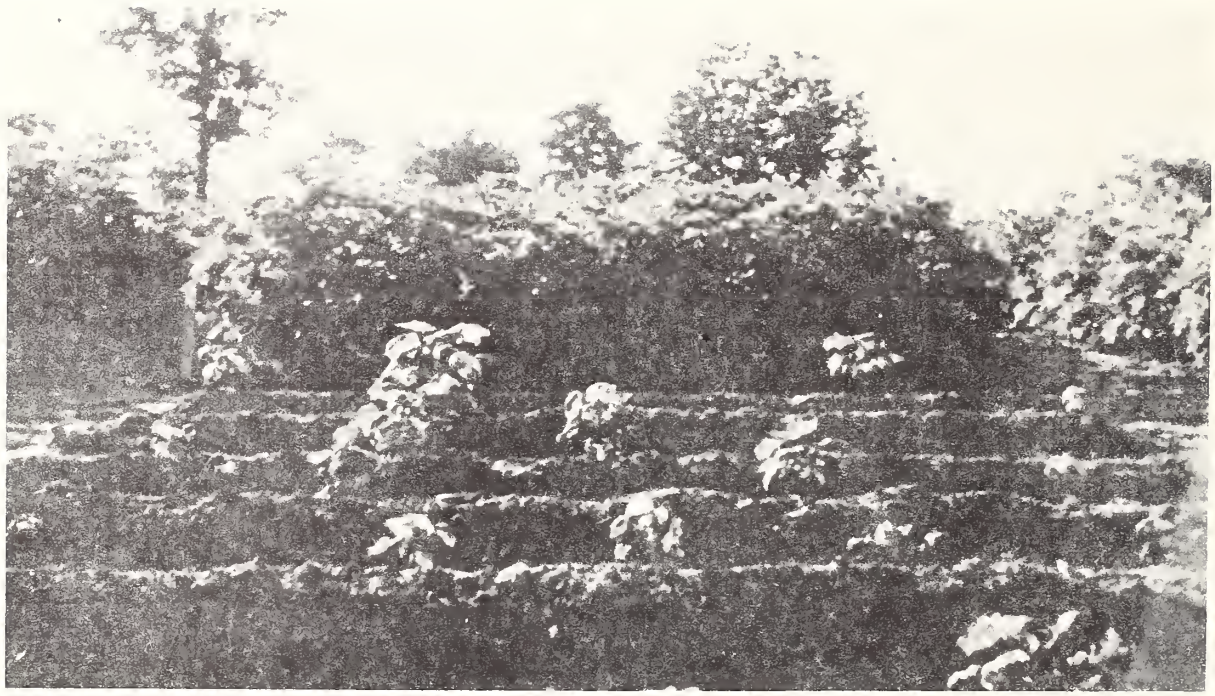


Figure 9.--Cotton in experimental plot at Agricultural Center in the northeast. Plants in background have been treated with pesticide; those in foreground have not.

1969 harvest. The lower 1970 prices were attributed to the lack of uniform quality in domestic cotton and to higher amounts of imports (49). Cotton farmers have been turning to corn, legumes, and sugarcane (49).

With production down and demand for spinning at high levels, imports of raw cotton will undoubtedly continue at high levels for the next several years. The United States is the largest supplier (table 16), but other countries have made substantial inroads. The competitive position of U.S. suppliers is expected to improve, partly through availability of better credit terms. In 1970, the value of U.S. exports of cotton was $8.5 million, 17 percent higher than in 1969 (table 24). In the first half of 1971, exports amounted to nearly $14 million, compared with $4.5 million in the first 6 months of 1970.

Cotton imported from the United States is usually about 1 inch in staple length (15). Most Thai mills are not equipped to handle longer staple cotton. Output of semilong staple cotton is largely for export. A relatively significant amount--3,400 tons--was exported for the first time in 1968. Hong Kong and Taiwan were the main markets. Foreign sales were up to 5,800 tons in 1969, but are expected to decline following the drop in domestic production (49).

About 40 percent of the cotton is grown in Sukhothai Province in the northern part of the Central Zone and another 11 percent in Loei in the northeast. The

rest is scattered throughout the country, but very little is grown in the peninsula. Planting generally starts in August or late in July. The bulk of harvesting occurs during December-February.

Climatic conditions in Thailand are not well suited to cotton cultivation and subject the crop to many hazards, especially from insects and diseases (15). Although in most areas, cotton is frequently subjected to excessive rainfall, droughts, as already noted, can do considerable harm. Virtually no Thai cotton land is irrigated (15).

In most years, seedling blight, angular leaf spot, and boll rot are the most serious cotton blights. For certain varieties that lack resistance to the leaf-sucking jassid (Empoasce devastans), cultivation is virtually impossible without a complete spray program (fig. 9). Other damaging pests are aphids, spiny bollworms, pink bollworms, and common bollworms. In some seasons, stem weevils, leaf rollers, loopers, leaf worms, thrips, and red spider mites can be harmful (15).

Considerable research has been done to develop varieties suited to local conditions. SK 32, which is resistant to the jassid, and Reba B50 are widely cultivated. Reba B50, which has an average staple length of 1-1/8 inch, is currently recommended by the Government (49), (6). This variety, however, is not resistant to insects and bollworms. The Thai Department of Agriculture is experimenting with a new and more suitable stock called BCK12, which could replace Reba B50 (49).

Kapok and Other Fibers

In output as well as value, kapok fiber by far exceeds cotton in Thailand. Estimates of annual production for recent years were:

	1,000 metric tons
Average:	
1957-61	81
1962-66	64
1967	79
1968	87

The fiber comes from the Salmalia malabarica tree (Bombax malabaricum), as well as Ceiba pentandra. Both trees produce pods containing a soft, silky mass of white fiber in which oil-yielding seeds are embedded. Most of the fiber is used within the country for stuffing furniture and mattresses; the rest is exported. Kapok is one of Thailand's largest farm exports to the United States, which in 1969 and 1968 took an average of nearly 12,000 tons out of total Thai exports of 17,000 tons. Almost half the trees are in the northeast.

Ramie, a fast-growing, strong fiber used mainly for fish netting, is produced mostly in the Central Zone. Quantities averaged 626 metric tons per year in 1963-67, or less than half the average amount in the early 1950's.

Jute is a minor crop. From 1960 through 1967, annual production varied from a minimum of 6,500 tons to a maximum of 11,600 tons. Most of the production is exported to the United States. The Thai Jute Association, which despite

its name deals primarily in kenaf, is attempting to develop jute cultivation, but no meaningful change is anticipated for a while.

Tobacco

Thailand both imports and exports tobacco. Total area in this crop more than doubled in the 1960's. Production and foreign trade, particularly exports, also expanded rapidly during the period (table 17).

Imports come almost exclusively from the United States. They are used for blending with local varieties in cigarette manufacturing. In most years, Thailand is the fifth or sixth largest market for U.S. leaf tobacco. The United States supplies mostly flue-cured tobacco (80 percent of total sales in 1968-69), but also burley. Despite a decline in Thai demand in 1970 (table 24), prospects for further exports of U.S. tobacco are expected to remain generally favorable. An increase in the import duty on tobacco from 40 percent to 60 percent ad valorem, in effect since mid-1970, may not seriously and permanently hold down the volume of U.S. sales. Acceptable substitutes for the type of tobacco imported from the United States are not readily available. Actually, in the first 6 months of 1971, the value of U.S. tobacco exports to Thailand was $5.5 million, or $1.2 million more than in the same 6-month period a year earlier.

While providing a sizable outlet for U.S. tobacco, Thailand is rapidly becoming a competitor in traditional U.S. markets, such as West Germany, the United Kingdom, Japan, the Netherlands, and France (50). Thailand's exports consist almost exclusively of flue-cured tobacco of the Virginia variety. Factors which may account for increasing exports of Thai tobacco are: low price; light body of the leaf (it takes less to fill a cigarette); and low nicotine content of Thai flue-cured tobacco (49). The embargo by most countries on imports of Rhodesia's tobacco has stimulated production of Thai flue-cured tobacco for export and will undoubtedly continue to aid foreign sales. Foreign trade in manufactured tobacco is very small.

Flue-cured tobacco was first grown in Thailand in the 1930's (50). It now accounts for about half of commercial tobacco cultivation. Most of the remaining crop consists of native, dark, sun-cured varieties. Small amounts of burley and oriental-type tobacco are grown almost exclusively for the market (49).

Tobacco is one of the Government's largest sources of revenue in Thailand. Imports and production are regulated by the Thai Tobacco Monopoly, a Government agency. Manufacture and sale of cigarettes are also reserved to the Tobacco Monopoly which, however, does not manufacture other tobacco products, except for small amounts of pipe tobacco. An American-owned firm locally manufactures small cigars with no filter, wrapped in homogenized tobacco (49).

The Monopoly grows about 60 percent of the crop for commercial use in its own fields and supervises production in fields planted by contract growers. Normally the Monopoly does the curing either directly or through private curers under contract with it. Because of the current high demand for flue-cured tobacco for export, independent curers are also allowed to operate (50).

In 1969/70, the producer price paid by the Monopoly was 15.27 baht per kilogram for flue-cured tobacco (49). Local varieties usually bring in about half the price of Virginia-type tobaccos (26). Tobacco curing is a seasonal activity which is considered a good source of supplementary income for a number of farmworkers (49). Government regulations require permits from the Tobacco Monopoly for planting tobacco, but these regulations are not strictly enforced. Many farm families in Thailand cultivate a patch of about 50 tobacco plants for their own use for chewing, hand-rolled cigarettes, or pipe tobacco. More than half the crop is grown in the Northern Zone; very little is planted in the south. The bulk of the crop is harvested in February.

The relationship between smoking and health so far has had no measurable impact on cigarette consumption in Thailand. No large-scale antismoking campaign has been mounted (49).

Other Crops

Cassava

Production of cassava, another crop which has expanded rapidly since the 1950's was 2.6 million tons of fresh root in 1970 and may reach 3 million tons in 1971. Cassava is grown primarily as a cash crop for export but some of it is used on the farm. Its insignificance as a food crop is undoubtedly an indication of the relative well-being of Thai farmers. In most tropical areas, cassava is grown mainly for subsistence, and in many underdeveloped countries is a significant component of the diet.

Most of the cassava is grown in two southeastern provinces, Chon Buri and Rayong, but some is planted throughout the country.

Cassava products, including pellets, flour, and meal, account for about 6 percent of Thailand's total export receipts. Most exports are now in the form of pellets. The United States is the chief customer for tapioca flour. The Netherlands and West Germany are the main outlets for pellets and meal, which do not come under the EEC import levy system (49).

Planting of cassava begins in the main producing area in November-December and elsewhere generally in May. The crop can be harvested 7-8 months after planting, but requires 15 months for best weight and quality. Farmers generally inform cassava dealers when they wish to sell their roots. The crop is uprooted by crews hired by the dealers who also use their own trucks to transport it to the processing plants (49).

Sugarcane, Sugar, and Molasses

As in other tropical countries, sugarcane for home consumption has been grown in Thailand for many centuries. However, until the 1950's, Thailand generally imported sugar. Since then, a remarkable expansion in production--aided and supported by the Government--has transformed Thailand into an exporter of sugar (table 18).

In 1970, Thailand had commitments to export 17,154 metric tons of raw sugar to the United States under the quota allocated by the United States, and 32,400

tons under the quota allocated by the International Sugar Agreement. Thailand was striving to find outlets for its sugar surplus of about 11,500 tons to stabilize the local industry and domestic prices of sugar (49). It was reported in July 1971 that Thailand would withdraw from the International Sugar Organization.

Exports of inedible molasses averaged some 70,000 metric tons per year in the late 1960's. Japan was the principal market. The United States took rather small amounts. Except for 1967 and 1968, imports have been nil. Foreign sales of Thai edible molasses are not significant.

Most of the sugarcane is grown by small farmers, who respond rather quickly to anticipated changes in the crop's prices (12). The factories with their own plantations also buy additional cane from individual farmers.

The Government's Sugar Institute provides technical and financial assistance to sugarcane farmers and technical assistance to the mills.

One province southeast of Bangkok--Chon Buri--accounts for one-third of the sugarcane area and almost half the sugarcane output.

Many Thai farms produce some noncentrifugal (jaggery) sugar, mainly for their own use, in simple on-the-farm mills. Some fresh cane is chewed or pressed into juice, which is made into an unfermented drink; some cane is used for fuel or wasted, partly because the mills cannot utilize it on time.

Sugarcane is usually planted in March-May. Milling begins in November. The cane may only be 6-8 months old when harvested, which often results in both low yields per hectare and low sugar content. Cane planted in October gives both higher yields and greater sugar content, since it is harvested a year later.

Dry Legumes

Mung beans (Phaseolus aureus) have long been cultivated in Thailand, primarily in the Central Zone but also on the Khorat Plateau. Production has been expanding rapidly and was estimated at about 180,000 metric tons in 1970, including the black type. Domestically, mung beans are used almost entirely for food, often as bean sprouts. Other dry legumes grown in Thailand include rice beans (Phaseolus calcaratus), lima-type beans, and cowpeas.

Exports of dry legumes consist largely of mung beans. Total dry legume exports rose from an average of 17,000 metric tons in 1956-60 to 72,000 in 1965-69. They amounted to more than 89,300 tons in 1969, and were at about the same level in 1970. Japan is the principal market, followed by Malaysia, Taiwan, Hong Kong, and Singapore. Thai imports of dry legumes are negligible.

Other Vegetables

Total production of other vegetables in Thailand is roughly estimated at 1.2 million metric tons a year. Commercial output is only a fraction of that amount. Common vegetables include chilies, onions, garlic, Chinese and other cabbage, eggplant, cauliflower, pumpkins, tomatoes, gourds, radishes, lettuce, celery, and bamboo shoots. Indigenous green shoots, tubers, and tree pods, as well as lotus,



Figure 10.--Farmer preparing land for cultivation of vegetables on Government-sponsored project near Khon Kaen.

which grows in the many ponds, are gathered throughout the country and eaten as fresh vegetables. Some mung beans, soybeans, and corn are eaten green.

Starchy tubers other than cassava are far less important in Thailand than in other Southeast Asian countries. According to official estimates, 1967 production (in thousands of metric tons) was: sweet potatoes, 204; potatoes, 7; yams, 49; and taro, 58.

Commercial vegetable growing is concentrated primarily in the vicinity of Bangkok, but is also common in the Chiang Mai area. Near Bangkok, commercial growing is carried out almost exclusively by ethnic Chinese in very intensively cultivated gardens. Many commercial vegetable growers raise hogs and sometimes ducks which utilize the waste and supply valuable manure.

In parts of the northeast, the Government, with assistance from the Agency for International Development (AID), is encouraging farmers to grow fresh vegetables as cash crops. The produce is grown by the farmers on privately owned fields with Government financial help and supervision (fig. 10).

International trade in vegetables is generally small. In most years, exports total some 5,000 tons (not counting dried chilies). Exports of dried chilies, mostly to Asian countries, are rapidly losing in importance. They were a mere 412 tons in 1969, compared with more than 9,300 in 1950. Between 2,000 and 5,000



Figure 11.--Bananas, papayas, and other farm products at Bangkok's floating market.

tons of shallots and onions are imported annually. India and Taiwan are the main suppliers of shallots. The Netherlands and Japan provide most of the onions.

Fruits

There are few commercial orchards in Thailand except in the area near Bangkok, but numerous types of fruits are grown in all sections of the country. Fruit trees and banana plants grow in almost every dooryard. Bangkok markets (fig. 11) offer a remarkable variety of fruit.

Annual production of bananas, the leading fruit, averaged about 1.3 million metric tons in 1964-67, compared with 344,000 tons in 1957-60. Exports seldom exceed 5,000 tons. Ripe bananas are generally eaten fresh, but they are sometimes dried and made into flour or chips (fig. 12) or are sliced and pickled. Two varieties, Kluai nam Wa and Kluai hom, have potential for export (12).

Pineapples and watermelons are the only other fruits for which statistics are available. Their production in recent years was:

Year	Pineapples	Watermelons
	1,000 metric tons	
1957	91	20
1961	450	117
1965	301	194
1967	202	244

Small quantities of pineapple are canned commercially with the participation of private American investors. Canned pineapples are a new Thai export to the United States.

The huge jackfruit and the related breadfruit, taken from wild or casually maintained trees, are food for poor people. Other fruits grown in Thailand include papayas; mangoes; mangosteens; citrus fruits (pomelos, limes, tangerines, and oranges); custard apples; jambalans; litchies and related longans; pomegranates; guavas; sapodillas; and tamarinds, which at present are the most



Figure 12.--Dried banana chips on sale in an open-air market along the Chao Phraya River in Bangkok.

important fruit export. Exports of tamarinds (mostly to Malaysia and the Near East) averaged 17,000 metric tons in 1968-69.

Certain amounts of bananas, pineapples, and other fruits are used for feed, partly because they cannot bring a profitable price on the local markets and partly because the cost of transportation to the urban markets is too high.

Miscellaneous Crops

About 800 tons of coffee and 400 tons of tea are produced annually.

Palmyra palms (fig. 6), found mainly in the peninsula and parts of the Central Plain, produce a fruit that is made to sprout for use as a green vegetable; the sap from the palm is made into noncentrifugal sugar or into an alcoholic drink (toddy).

The oil palm is a crop which might be grown in the south. Thus far, its cultivation has not been successful (49).

The beetlenut or areca palm grows in many parts of Thailand, especially the coastal areas. The nut contains a mild stimulant, which is habit forming. Dried pieces of the nut, mixed with other ingredients, are commonly chewed by the Thai.

Mulberry trees, whose leaves are used to feed silkworms, are grown in scattered areas of the northeast, generally in plots of less than 1 acre. The Thai raw-silk industry grew from one company in 1941 to some 150 companies in 1969, employing several thousand workers and involving some 245,000 families. Annual output of raw silk in the late 1960's was about 350 tons. Private American interests have contributed to the development of the industry. Silk has become a tourist attraction and a sizable earner of foreign exchange. Expansion and improvement of raw-silk production are receiving continued attention from the Government (49).

Orchids are exported from Thailand to about 15 countries, including the United States. More than 4 million blooms were shipped in 1968 (29).

LIVESTOCK AND PRODUCTS

Thai farmers generally keep one to four draft animals (used also for meat), a few chickens and ducks, and one or two hogs. The total value of livestock production is normally less than one-fifth of total farm production.

Livestock Numbers and Breeds

Water Buffaloes

In Thailand, water buffaloes are the most numerous of the large livestock (table 19). They are more important than cattle as draft animals, as they are more suitable for working the flooded ricefields (fig. 13) and have the strength required to pull the plow or harrow through the thick mud. A water buffalo can plow about one-sixth of a hectare of riceland per day. Buffaloes



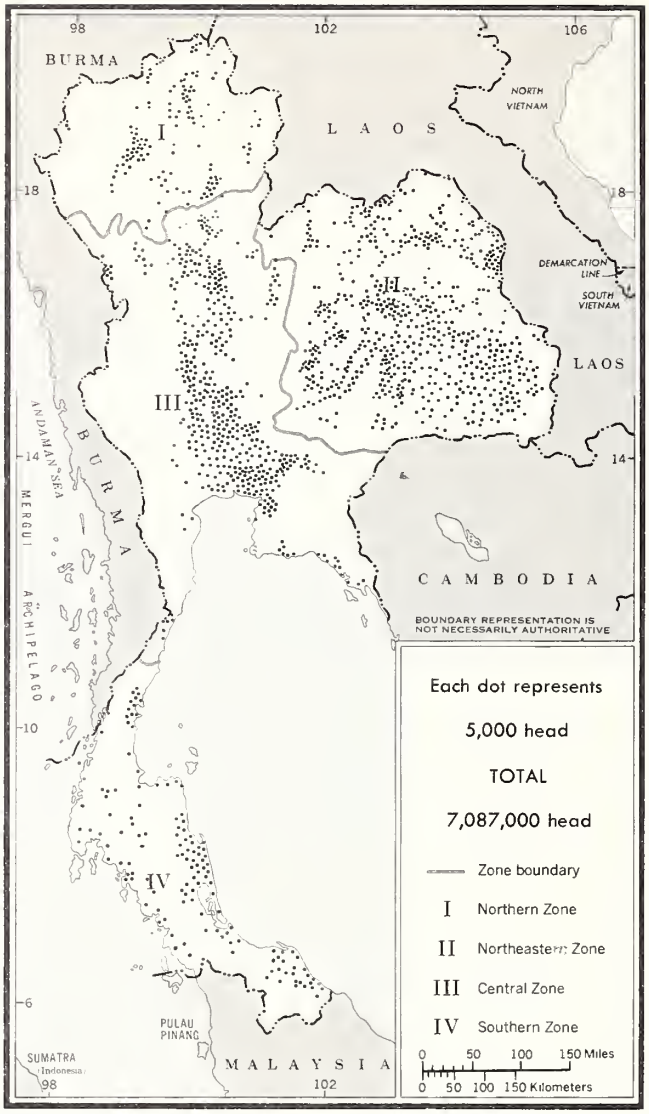
Figure 13.--Water buffaloes plowing flooded paddy fields.

are present in all farming areas of Thailand (fig. 14). When no longer useful for draft purposes, the buffalo is sold for meat. Some buffaloes are raised exclusively for meat and are slaughtered in prime condition.

Working buffaloes are replaced every 5-6 years. Most of them are raised in the northeast and sold to other parts of the country, particularly the Central Plain, when they are 3 or 4 years of age (22).

Most of the animals are of the swamp type (as differentiated from the river type). The swamp buffalo has a heavy, stocky body with a short trunk, comparatively long neck, and widespreading horns. There are several local strains. The Kwai Tui has black skin and hair and is typical of those prevalent on the Central Plain; the Kwai Kam is a smaller animal with grayish skin and hair. The swamp buffalo thrives on coarse fodder and poor roughage that no other domestic animal can digest (22).

A few of Thailand's buffaloes belong to the Murrah (Indian) breed, a river type. The Murrah are relatively good milk producers, and are used for this purpose, as well as for work. The swamp buffalo gives just enough milk to feed its calf.

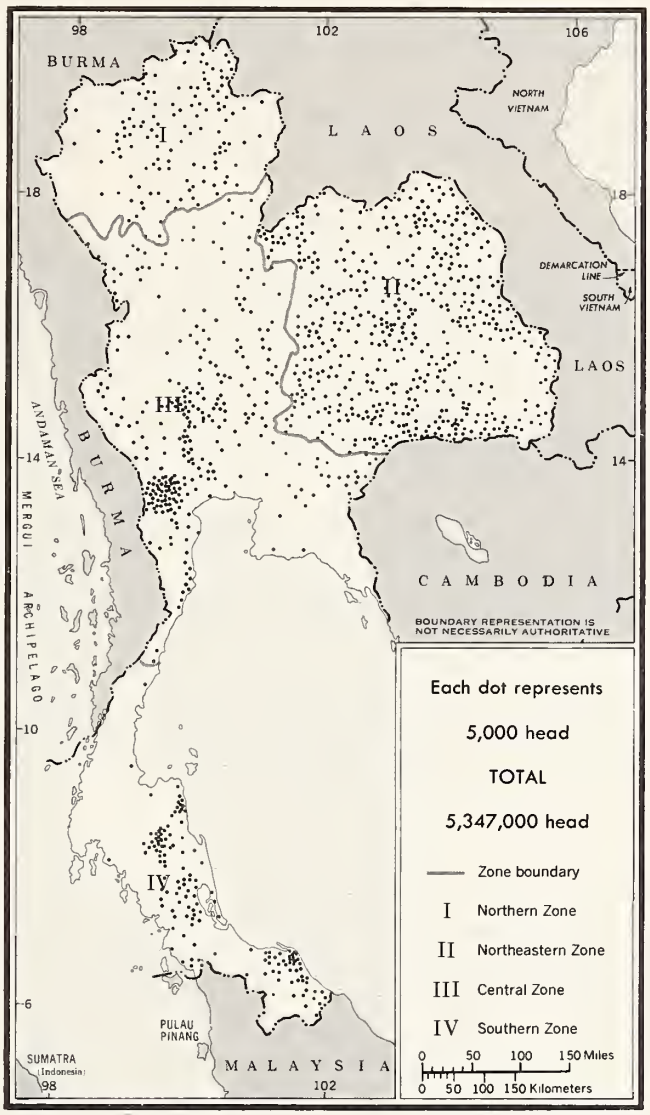


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Figure 14.--Distribution of buffaloes, 1963.

Cattle

The small Thai cattle are used chiefly to pull carts and to plow in the upland areas. Cattle, like buffaloes, are sold for meat after they have outlived their usefulness as draft animals. There are very few beef and dairy types of cattle in Thailand, but attempts are being made to introduce them. As part of a livestock improvement program launched as far back as 1954, several hundred head of breeding stock, including American Brahman, Santa Gertrudis, and Pakistan Red beef cattle, as well as Brown Swiss dairy cattle, have been imported. The United States has supplied a large share of the imports. In 1969, it sold Thailand more than 400 head of purebred cattle. Australia is another important supplier of breeding stock. Generally, imported breeding cattle are kept at about 15 Government livestock stations scattered throughout the country, and



U.S.D.A. NEG. ERS 8116-71(1)

Figure 15.--Distribution of cattle, 1963

are crossbred with native animals. Artificial insemination is also used, particularly to breed dairy cattle. The breeding program has been fairly successful in the vicinity of the livestock stations.

Cattle are more widely distributed than buffaloes (fig. 15), but are less numerous on the Central Plain. Farmers in the Central Zone and the northeast are reported to be increasingly interested in cattle farming (49). Opportunities may exist for the establishment of joint U.S.-Thai ventures in producing beef cattle (18).

Hogs

Indigenous hogs are mainly of three breeds--the Red from the northeast, the Kwai from the north, and the Hainan from the Central Plain. Imported Hampshire,

Berkshire, Landrace, Duroc-Jersey, and Large White boars have been used in crossbreeding. Some experts have suggested that indiscriminate crossbreeding and inbreeding have diluted the desirable characteristics of the indigenous breeds, especially the Hainan hog. Proper crossbreeding, however, could improve carcass quality and significantly increase pork production.

Poultry

Poultry is one of the rapidly growing sectors of Thai agriculture. Since World War II, various breeds have been introduced, such as White Leghorn, Rhode Island Red, Barred Plymouth Rock, and New Hampshire from the United States, and Australop from Australia. These imported breeds make up the commercial flocks; some have been distributed to rural areas, under various Government programs, for crossbreeding with local birds. The small native Thai chicken (averaging 0.8 kilogram) is a low producer of both meat and eggs.

A number of commercial chicken producers have flocks of several thousand birds. One enterprise near Bangkok reportedly has a million chickens (51). Private American capital has been invested in poultry raising and processing in Thailand (18).

Ducks account for about one-third of total poultry numbers and are mainly of the Khaki Campbell breed. They are usually kept in fair-sized flocks. Duck breeders, almost exclusively Chinese, run primarily family-type establishments, using traditional methods. Hatching is carried out on nests made of rice hulls (51).

Other Livestock

Thailand has only a few thousand sheep and goats, and there is no indication that these classes of livestock have significant potential in the country.

Relatively few horses and practically no mules or asses are kept. Equines do not stand up well in the wet tropical climate, and they suffer from a number of diseases. Most of these animals are found in the northern mountainous country, where they are used as pack animals. A few racehorses are kept in Thailand.

Livestock Management

Large-scale raising of livestock is virtually unknown in Thailand except for a handful of commercial enterprises engaged primarily in poultry production. Since most breeders own a very small number of animals, the general adoption of improved technology is particularly difficult.

Animals are usually poorly housed and inadequately nourished. They are kept in simple enclosures underneath the farmer's living quarters, which are raised on stilts above the animals' pen; in areas subject to periodic flooding, livestock are kept in enclosures on elevated ground.

Fodder comes primarily from natural pasture, including local grasses growing along ponds. Virtually no crops are planted exclusively for forage. The nutritive value of much of the forage is limited, as the browse often consists

of weeds and unpalatable native grasses that are low in protein (43). In isolated cases, commercial breeders use pasture planted with good grass (49). A Pasture and Range Development Project has been initiated to improve grazing land and encourage the introduction of temporary meadows into the crop-rotation system, but progress has been slow.

Supplemental feed is usually inadequate. Livestock, particularly hogs and poultry, are generally fed rice bran and some broken rice. The larger chicken farms use mixed feed, but Thai feed mills produce mainly for export (43). Feed processing is another sector of the Thai economy which American private investors are helping expand (18).

There is, of course, a strong correlation between poor animal nutrition and susceptibility to parasites and diseases. Animal diseases are numerous in Thailand (appendix); external and internal parasites are common. There is a heavy infestation of liver flukes in all classes of livestock. Ticks lower animal health and vitality throughout the country.

Control of livestock and poultry pests is not entirely satisfactory, although Thailand has one of Southeast Asia's largest and best veterinary services. Vaccination against hog cholera and cowpox and preventive measures against rinderpest and foot-and-mouth disease have been carried out in recent years, but on a rather small scale. The livestock programs of the Second Development Plan emphasize the eradication of foot-and-mouth disease, hog cholera, and trichinosis (38), (51). Control and eradication of livestock diseases and parasites and the development of a corps of trained veterinary officials are among the objectives of a Livestock Development Program initiated by the Government, with AID help, in the northeast. This program also aims at replacing traditional unproductive animal-feeding systems with simple, practical, and economical feeding plans that the farmer can implement after observing demonstrations. Artificial insemination, castration of poorer animals, and improvement of sheds for housing hogs and chickens are also being carried out as part of this program (43), (47).

Qualified observers believe that in the long run, nutrition, health, and physical environment are not insurmountable obstacles to the exploitation and growth of the livestock sector in Thailand, but improvements in these fields, must, of necessity, be accompanied by the provision of economic incentives (43).

Livestock Products

Thailand's otuput of livestock products is low, but so is per capita consumption. The country is a small net exporter of most livestock products, except for dairy products which are procured largely from abroad and account for a very large share of the total value of Thai farm imports.

In value, poultry and eggs account for nearly 36 percent of total livestock production, hogs for 33 percent, cattle and cow's milk for 21 percent, and buffaloes for the remaining 10 percent. No value is imputed in Thai national accounts statistics to production from other animals.

Meat

Estimates of meat production are only rough approximations and vary considerably. Commercial slaughter is said to account for well under half of total meat production. Output from inspected slaughter has expanded slightly during the past decade according to FAO, but has declined according to other sources. However, since the mid-1960's, annual meat production from recorded slaughter has been about 100,000-135,000 metric tons for pork, the principal meat in Thailand; and approximately 70,000 tons for beef and buffalo meat (of this, between one-fourth and one-third is beef). Approximately 40,000-42,000 tons of poultry meat are produced each year, with chickens accounting for perhaps two-thirds and ducks for virtually all the rest. Broiler production is increasing to meet restaurant, hotel, and supermarket needs for both fresh and frozen packages (49).

Slaughtering centers are run mostly by Chinese, as Thai generally observe the Buddhist injunction against animal slaughter.

Less than 100 tons of beef and poultry are imported annually, mostly for the tourist trade. New Zealand is the largest supplier of beef. The United States is the largest source of poultry meat, including frozen turkeys.

Virtually no meat is exported as such from Thailand. Numbers of live animals for slaughter exported principally to Hong Kong, Singapore, and Malaysia are:

Year	Buffalo	Cattle	Hogs	Poultry
		1,000		
Average:				
1951-55	6	1	5	327
1956-60	55	1	19	991
1961-65	54	6	50	387
1966	46	9	13	199
1967	40	11	11	311
1968	23	8	10	316
1969	26	9	4	399

Dairy Products

Most Thai consume little milk, butter, or cheese, but consumption is reportedly increasing. Ice cream is becoming popular in urban areas. Farm production of fresh milk is not officially recorded. Probably, it amounts to no more than 10,000 metric tons per year. Only 7,000-8,000 quarts of fresh milk are supplied to Bangkok daily (49).

For several years, the Government has been attempting to develop the dairy sector, but as production figures for fresh milk indicate, progress has been slow. Help has been received from Denmark and West Germany. A Dairy Promotion

Center has been established at Chiang Mai and a few dairy herds are kept near Bangkok. In 1969, restrictions were placed on imports of powdered milk to encourage sales of fresh milk (49).

The main dairy products imported, which come primarily from the Netherlands, are:

Year	Condensed milk	Evaporated milk	Dried milk
	1,000 metric tons		
Average:			
1956-60	39	6	1.2
1961-65	46	8	2.9
1966	36	9	8.9
1967	28	10	11.5
1968	23	11	15.8
1969	13	10	25.8

Imports from the United States, while still modest, are now at much higher levels than in most of the 1960's (table 24). Imports of fresh milk and cheese are negligible. The sharp increase in imports of dried milk and the decline in those of condensed milk have resulted primarily from the construction in Thailand of a number of condenseries which produce recombined and sweetened milk from imported raw materials. Five condenseries were in operation in 1969. Two American firms are manufacturing milk products in Thailand.

Other Products

Egg production in Thailand is probably close to 100,000 metric tons annually. In most recent years, exports have been 5,000 to 6,000 tons annually. As statistics on animal slaughter are unreliable, estimates of hide and skin production are no better. Exports of undressed cow and buffalo hides (mostly buffalo hides) averaged 6,000 metric tons a year in 1965-69. Data on production of silk cocoons are not recorded.

FOOD CONSUMPTION

Thailand is one of the few countries in Asia with an exportable surplus of both food and feed. Food availability is generally good throughout the country, except in parts of the northeast. Average per capita consumption of food, in energy value, is currently estimated at some 2,200 calories, but is probably considerably understated. In years of poor crops, farmers may have smaller than normal surpluses or no surpluses of rice for sale, and exports of rice may have to be curbed to meet the needs of the urban population, but rarely do people go without food (2).

The average Thai diet, however, is limited in variety and somewhat deficient in proteins. Rice accounts for almost 70 percent of the caloric intake. Food is placed in two categories: khao (rice) and kab khao (food eaten with rice).

Fish, traditionally the second most important food, provides about half the animal protein. Although rice remains the basis of meals at all income levels, increased prosperity is bringing about some improvement in the qualtiy of the diet. Meat and fish consumption for the country as a whole is believed to be increasing somewhat.

In the Bangkok metropolitan area, the diet includes more meat, eggs, vegetables, fruits, fish, and canned food--and less rice--than in the rest of the country. Regional dietary variations are slight in the rural areas, but less fish is available in the northeast and north, and more coconut is eaten in the south. In the vicinity of Bangkok, more vegetables and meat products are eaten (2). The typical diet in urban areas other than Bangkok differs only slightly from that in the countryside.

The somewhat poor quality of the average diet causes malnutrition problems, which are aggravated among some groups by internal parasites. Deficiency of vitamins other than vitamin C is widespread, especially among poorer people, infants, and children (2), (17). Beriberi is fairly common. The vitamin deficiency problem has been magnified by the increasing preference for commercially milled rice, which has less nutritional value than home-pounded rice. For some years, the Government has had a program for improving nutritional standards. Its effectiveness, so far, has been limited to relatively small areas (13).

AGRICULTURAL POLICIES AND INSTITUTIONS

Government Policy

Agricultural Development

The fundamental role of agriculture in the development of the country's economy was formally recognized in Thailand's First Development Plan (1961-66) and reemphasized in the Second Development Plan (1967-71). The share of expenditures for agriculture increased from 14 percent of the total in the first plan to 20 percent in the second. The main objectives of Thailand's farm policy, as stated in the second plan, are to expand and diversify agricultural production; increase the real income of the farmer by ensuring that the benefits of higher production accrue to him; and improve his socioeconomic condition (38). 7/

Achievement of the Government's broad agricultural aims is being sought through various measures, which include: improvement of the rural infrastructure, particularly irrigation and transportation; provision of greater and improved inputs; strengthening of agricultural research and experimentation; strengthening

7/ Yet as has been pointed out, during the period of the Second Development Plan, the share of agriculture in the gross domestic product is expected to decrease from 31.6 percent to 26.0 percent, while employment in agriculture is to decline only from 79.9 percent to 75.6 percent (26), (38).

of agricultural institutions and organizations; improvement of the marketing system and grading of farm products; and provision of more Government services to the farmer, particularly in extension, rural credit, and price support for the major farm commodities. (Most of the steps being taken by the Government to implement its agricultural program are discussed in some detail elsewhere in this report.)

In promoting agricultural growth, the Government is becoming increasingly committed to reducing regional differences in farm incomes by raising incomes in the poorer areas. The difference in the level of farm incomes between the Central Zone and all other zones is high, as shown below for 1963 (41):

Area	Average annual farm income		
	Of farm origin	Of nonfarm origin	Total
	Baht		
Central Zone (excluding northern part)	7,791	2,086	9,877
Southern Zone	3,953	2,408	6,361
Northern Zone (including upper part of Central Zone)	4,138	1,346	5,484
Northeastern Zone	3,490	1,352	4,842
Thailand	4,735	1,677	6,412

Also in 1963, urban family income averaged 13,090 baht in all towns, and 18,690 in the Bangkok-Thon Buri metropolitan area alone (40). 8/

While continuing to promote development of areas with the greatest potential for overall growth (mainly in the Central Zone), the Government has started several regional programs in the disadvantaged areas. The Accelerated Rural Development Program is designed to concentrate and intensify development activities in selected provinces. Since 1965, it has operated in 14 provinces in the northeast and six border provinces in the north. The program coordinates several activities which include--in addition to all aspects of agriculture--education, public health, public administration, and public works. Through an Agribusiness Project, which covers the entire northeast, the Government seeks to promote economic development by encouraging local conversion of primary farm commodities to higher value products, such as meat, vegetable oils, and silk. Greater emphasis on regional development is anticipated under the third development plan.

The Government is expected to continue encouraging the establishment of industries in the agribusiness sector and to continue providing a political and economic environment conductive to foreign investment.

8/ At par value, ฿1,000 = US$48.08.

Private Japanese capital is taking advantage of the favorable climate for trade and investment. It is making a tangible contribution to the commercialization of Thai farm production and to the development of the agribusiness sector (47), (49). In the long run, there might be scope for increased participation by private American capital, particularly small investors, in a few fields including livestock raising, grain storage, marketing, and processing (18).

Internal Market and Price Regulation

Traditionally, Thai farmers have been subject to a buyers' market. But in the mid-1960's, with the progress of farm production diversification and the increased concern for rural welfare, the Government began operating a minimum price guarantee program. In 1970, farm price guarantees were in effect for rice, corn, kenaf, cotton, and sugarcane (47), (49). For rice, the base for the floor price is the Bangkok market; prices outside Bangkok take into account the cost of transportation to that market. For the other crops, the guarantee is put into effect on a case basis and differs with locality (49). The Public Warehouse Organization of the Ministry of Economic Affairs manages most of these programs. This organization is also charged with preventing excessive increases in the consumer price of rice. When action is considered necessary, the Public Warehouse sells from its accumulated stocks of rice to the trade at prices below current market levels. The Rice Reserve Committee, whose main function is to ensure adequate supplies of rice for domestic consumption and export, is also designated as purchasing unit under the rice price-support program (34).

In the past, few purchases have been made under the price-guarantee program. Usually, the guaranteed price has been well below the actual market level. When the market price has fallen below the minimum guarantee, the mere presence in a market of Government purchasing agents has generally been enough to cause the price to rise above the floor level. But there have also been cases when market prices were below the established minimum, and the Government was unable to make the required purchases. This latter situation is expected to occur less frequently in the future, since the Government is becoming better equipped to implement its price-guarantee programs.

There are no direct support payments on crop and livestock production but, as pointed out elsewhere, several benefits are available to farmers from the Government. For instance, irrigation water is made available free; only a nominal charge is made for artificial insemination of livestock; fertilizer for rice farmers belonging to Farmers Clubs is subsidized; and no charge is made to vaccinate animals in case of pest outbreaks.

There are no compulsory crop-delivery systems in Thailand. While there is monopoly purchasing of tobacco by the Tobacco Monopoly, a large part of the crop is produced outside its control (49).

Regulation of meat marketing and pricing is limited to the Bangkok metropolitan area, which, however, accounts for a large share of the meat marketed in the nation. Until mid-1968, all meat sold in Bangkok had to come from animals slaughtered at the municipal slaughterhouse. A Government agency is now allowed to bring pork into the city. Provinces are assigned quotas for the live animals they can send to the slaughterhouse.

Agricultural Organizations

Cooperatives

The cooperative movement in Thailand is more than 50 years old. Until the late 1930's, cooperative societies consisted only of farm credit associations (see section on "Farm Credit"). Since then, other types, such as land and marketing cooperatives, have been organized (2). Multiple-purpose associations which provide credit, production inputs, and marketing services have been established in the north and northeast. Organization of more cooperatives of this type is anticipated.

Most of the marketing societies are subsidized and receive free or low-interest credit, as well as free management services (16). Marketing cooperatives occasionally act as supply cooperatives by purchasing and selling farm requisites at lower rates than they are available commercially, but relatively little effort has been devoted by the cooperatives to developing supply activities (16), (43).

There are three types of land cooperatives: (1) Land settlement cooperatives, first introduced in 1938 and established by the Government to help farmers with too little or no land to settle on uncultivated areas set aside for this purpose; (2) land hire-purchase and tenant cooperatives, organized among tenants to enable them to purchase land on the installment plan or to rent land at more reasonable rates; and (3) land development cooperatives, formed mainly to use water supplies collectively and to help farmers adopt modern practices, such as fertilization and crop rotation. The 1967-71 Development Plan calls for the strengthening and expansion of all these cooperatives (38).

The number of cooperatives and their membership in 1966 were (13):

Type of cooperative	Number	Membership
Credit	9,881	160,200
Land	517	32,900
Marketing	177	85,000
Nonagricultural	236	236,300

There were over 11,000 credit cooperatives in 1970 (43).

A substantial proportion of the members of nonagricultural cooperatives are farmers. These associations include cooperatives for such activities as sugar processing, silk weaving, and tobacco curing and a few for electricity and waterworks. The Government is receiving AID's help in its attempt to improve cooperatives.

Other Farmers Organizations

Several different types of farmers' organizations have been established under Government sponsorship. These are generally referred to as Farmers

Clubs. In 1968, they reportedly had a membership of about 200,000 farm families and had been formed in every province of the country. A national association of these groups has been formed and recognized (16).

Although most clubs were organized to facilitate extension and educational efforts, their functions are becoming not unlike those of the cooperatives. Their objectives generally include group action to obtain fair prices for their products and supplies, obtain or supply credit for their members, and undertake land improvement. Farmers who are members of the clubs get subsidized inputs and credit from the Government, largely through the Farmers' Aid Fund. In general, these clubs appear to be functioning more successfully than the cooperatives (16).

Trade and processing groups for commodities such as cotton, kenaf and jute, corn, and cassava are well organized and are members of the Board of Export Promotion (49). An association of agricultural economists is fairly active.

Government Organizations

The Ministry of Agriculture (which is made up of various departments, including the Departments of Agriculture, Rice, and Extension) and the Ministry of National Development are the two principal institutions dealing with agriculture. The role of the latter is expanding considerably, in keeping with the Government's increasing involvement in agricultural planning and development. The Ministry of National Development includes the Irrigation Department; the Department of Cooperatives; and the Department of Land Development, which is responsible for the technical aspects of land development, as well as the investigation and improvement of the farmers' socioeconomic conditions.

Reference is made elsewhere to the principal organizations regulating domestic and international marketing of farm products. The Ministry of Economic Affairs is at the top of the national agencies responsible for marketing crops (34).

Marketing Channels

Thailand has a marketing system which on the whole has been capable of responding to the demands of the market and moving the goods from farm to consumer or export point. Farm commodity traders, mostly Chinese, have been largely responsible for drawing small farmers into the money economy and offering them the economic incentives to expand and diversify production.

However, it is generally recognized that marketing shortcomings--including uneven quality of products, lack of storage facilities, and inadequate road and rail transportation--are inhibiting factors in Thailand's agricultural economy and hold down the farmer's income, as well as the volume and value of agricultural exports (50).

Most farmers have to move their crops to market immediately after harvest, not only for lack of storage space but also to satisfy debts, obtain cash for living expenses, make purchases for farm needs, and the like (50). Most of the

produce enters trade channels "as is," and along the line is made ready for world trade. Established grade standards are enforced only for a limited number of export commodities (34), (50).

The Government is stressing the need to improve the marketing structure and will continue to give priority to road construction. Over most of the country, market news has often been untimely, limited in scope, and in general available only to traders (31), (33), (47). But a market news service has now been started with AID assistance. 9/ For centuries, the river was the only year-round transportation route to city markets (and more than two-thirds of the marketed rice continues to be shipped by barge). However, new highways and feeder roads are providing an increasingly large number of farmers with better access to market or collecting centers (50). Much produce moves into upcountry centers on the farmer's head or shoulders, by bicycle, and by farm cart. In the northeast, about 50 percent of the villages remain inaccessible to motor vehicles during the rainy season and some 10 percent are inaccessible year round (43). However, nearly all provinces are now reached by all-weather roads.

Although there are a few provincial terminal markets, Bangkok is the focal point of the marketing and transportation systems. An exception to this basic pattern is rubber, most of which is exported from peninsular ports (2). Trade and transportation facilities between the provinces remain rather limited.

Commodities moved from the provinces to Bangkok consist largely of farm products. The major item in bulk and value is rice. Livestock, poultry, vegetables, and fruits are also important.

There is considerable movement of draft and meat animals from the northeast to the Central Plain and the south. Herds of buffaloes and cattle (numbering from a few hundred to about a thousand) are driven to Bangkok for slaughter, usually from April to July. The Bangkok slaughterhouse, which controls almost all the meat marketed in that city (see section on "Internal Market and Price Regulation"), is a modern installation with good refrigeration facilities.

Marketing of crops and livestock from farm gate to consumer or export point is generally handled by four or five separate groups of middlemen (25). A number of large wholesalers maintain retail outlets or may also sell directly to consumers. In general, these same firms, along with specialized enterprises, also handle imports of farm products, as well as general merchandise. Nearly all the large wholesale firms are located in Bangkok.

Farm Credit

Seasonal borrowing for working capital and consumption is the most common type of debt among Thai farmers. Generally, these loans are repaid soon after the harvest. Medium- and long-term debts for capital improvement are rather uncommon, although a small group of larger and more prosperous farmers makes regular use of them (20).

9/ See also Establishing Market Information Services in Less Developed Areas, A Practical Case in Northeastern Thailand, No. 10 in (14).

About two-thirds of Thai farmers are believed to use credit, but nearly all the landless tenants in the Central Plain are in debt (20), (28), (35).

Moneylenders, village shopkeepers, crop buyers, other commercial groups, and landlords account for almost half the farm credit provided, and relatives and friends for most of the rest. The share of farm credit provided by financial institutions is variously estimated at between 3 and 10 percent of total farm credit outstanding, which is put at 9-12 billion baht (20), (51).

The major institution for farm credit is the Bank for Agriculture and Agricultural Cooperatives; it was established in 1966, when it replaced the Bank for Cooperatives. It provides supervised credit to farmers directly and to agricultural cooperatives for relending to farmers. At the beginning of 1970, the Bank had a total of 640 million baht in outstanding loans. Total loans to agriculture amounted to about 696 million baht in 1969. Total amounts loaned directly to farmers are generally much higher than total amounts loaned to cooperatives. Some 200,000 farmers have obtained loans from the Bank and some 155,000 from the local cooperatives (6), (43).

The Bank receives deposits and provides other banking services. At the end of 1969, it had 35 branches and 187 field offices. It aims to have 57 branches by the end of the Second Development Plan.

The Bank makes unsecured small production loans to individual farmers for principal crops, and lends against collateral up to 60 percent of its value. Loans for farm operating expenses are repayable in 1 year. Loans for farm improvement and purchases of equipment and machinery are repayable within 3 years.

The interest rate is 12 percent per annum on loans to farmers and 9 percent on loans to agricultural cooperatives. The cooperatives charge 12 percent on their loans to farmers (43).

The legal limit of annual interest rates on loans in Thailand has stood at 14 percent since 1868, but this is usually exceeded except for loans from non-institutional sources. Rates of interest paid to sources of credit other than cooperatives and banks range between 18 and 45 percent. Private loans sometimes cost as much as 60 percent or more. Effective rates are often higher than stated because the loans are repaid in kind at the relatively low price prevailing at harvesttime.

Farm credit cooperatives lend funds to members, mostly as short- or medium-term loans. The agricultural credit cooperatives in Thailand are of the Raiffeisen type, with unlimited liability for all members. The cooperatives obtain some of their funds from deposits of members and nonmembers, but chiefly from loans from the Bank for Agriculture and Agricultural Cooperatives.

Commercial credit institutions extend a small amount of agricultural credit. The Bangkok Bank, Ltd., one of Thailand's largest banks, established an agricultural credit scheme in 1963 whereby farmers, either individually or as members of joint-liability groups, can obtain loans for farm improvement (5). During 1968, some 32,000 farmers borrowed 94 million baht at an annual interest rate of 12 percent. Nearly all the participants in the Bangkok Bank programs are small farmers (65 percent of them tenants), but the few large farmers who obtain

individual loans account for a disproportionately large share of the total credit outstanding (5), (47).

By special arrangement with the Government, five commercial banks provide Government-guaranteed loans to farmers in areas covered by the Accelerated Rural Development Program. Loans under this arrangement amounted to 6.3 million baht in 1969 (43).

Education, Research, and Extension

The vast majority of Thai farmers have inadequate education and technical training. About 36 percent of the farm operators are illiterate and 19 percent have less than a fourth-grade education. Schooling through the seventh grade is compulsory, but only 28 percent of the children are said to attend school past the fourth grade. Only about 10 percent go to secondary schools. In 1960, about 14 percent of the children 10-14 years of age were illiterate. For those in school, the curriculum includes little that is of direct value to them as future farm operators. Farmers with the equivalent of a high school education are very rare.

Despite the low level of education and the widespread illiteracy, experts who have had extensive contacts with Thai farmers are generally convinced of their inherent ability to improve their farm operations, if they obtain help either directly or through group organization (16).

There are several vocational agriculture schools in the country which in the past have been of limited effectiveness but are now being strengthened. However, vocational agriculture schools start after the 10th grade and those who have not gone on to secondary school are not admitted.

Advanced agricultural education is offered at Kasetsart University (located near Bangkok), whose main purpose has traditionally been to train students for Government service (8). Total enrollment is about 2,500 students.

Chulalongkorn University in Bangkok has a veterinary school. The Universities of Chiang Mai and Khon Kaen each have an Agricultural College; the University of the South, at Pattani, is scheduled to have one.

In the past 15 years or so, research has helped to increase yields and diversify crop production. However, it is generally believed that much more is necessary to make research entirely attuned to Thailand's needs for agricultural development. With the help of foreign exports and capital, Government efforts are being directed to the achievement of this goal. For instance, work is being done on improved varieties of crops adapted to Thailand, irrigation cropping, fertilization rates, soil testing, and improved farming equipment. Better coordination of the research effort is also being sought.

Research thus far has been conducted by different agencies, based on their respective responsibilities. The Department of Rice is concerned with rice at its 18 experimental stations and Rice Protection Research Center; the Department of Agriculture is responsible for all other crops; the Department of Livestock takes care of fodder and pasture; and the Irrigation Department, application of irrigation (12). There are a number of specialized research centers, each

responsible for a separate crop, such as rubber, tobacco, or cotton. Kasetsart University has research programs of its own, and conducts a program for corn and sorghum with the Rockefeller Foundation and the Ministry of Agriculture.

Two regional agricultural centers have been established in recent years. They conduct research on most aspects of farming. One center is located near Khon Kaen in the northeast, and operates with the help of the University of Kentucky (under an AID program); the other center is at Chainat in the Central Plain, and is assisted by the Colombo Plan. Establishment of one research center for each major farming region is planned.

The extension service cannot be fully efficient as long as research knowledge is basically fragmentary. Several other handicaps exist. Extension agents are too few in relation to the number of farms they are expected to service. Also, Thai farmers, on the whole, run small-input, small-risk, low-return operations and have little or no use for the findings of research, since they cannot reproduce the condition under which crops are grown at the research stations.

Nevertheless, some of the research results are beginning to find practical application and the extension service has had some success in carrying the new technology to the farmer. A number of demonstration plots are operated. A program for setting up demonstration farms has been in existence for a few years. These farms are 30 to 60 hectares in size. They often consist of adjacent plots owned by different farmers; in such cases, all profits from the farming operations go to the landowners.

An attempt is being made to improve and strengthen all aspects of the extension service and to obtain better coordination between it and the research centers. In 1968, the extension branches of the various Government departments were combined into one Extension Department within the Ministry of Agriculture. Some commercial firms also provide a number of growers with extension-type services.

Foreign Aid

Since the end of World War II, assistance to Thailand from all sources has totaled approximately $1.6 billion, about three-fifths of it for economic aid. The United States is by far the largest single contributor and has provided about three-fourths of the total.

Although most of the aid for development has been to improve the infrastructure--which benefits agriculture only indirectly--foreign technical and financial aid has been an important factor in Thai agricultural development. Of the B11.4 billion allocated to agriculture by the 1967-71 Development Plan nearly B2 billion comes from foreign loans and B550 million from foreign grants (38). 10/ In 1968 and 1969, more than B1 billion was received annually in foreign aid for economic development. About 15 percent of this aid was for agriculture (49). Among the major contributions of technical aid are research

10/ B1 billion = US$48,076,000.

into improved varieties of crops adapted to local conditions, upbreeding of livestock, and strengthening of research in agricultural economics (26).

Currently, U.S. support to Thai agriculture is largely for programs in the northeast and north (43). Some of the more important U.S. programs have already been mentioned. They include livestock development, agricultural research and extension, soil and water development, cooperatives and Farmers' Clubs, credit, agricultural economics, the Northeast Agribusiness Project, and the Accelerated Rural Development Program (43).

Japan has begun actively promoting the expansion of farm production in Thailand. Japanese exports are providing help in a variety of fields including sericulture, soybean production, rice physiology and entomology, cassava processing, river-basin planning, and agricultural pesticides. Future Japanese programs for technical assistance are likely to concentrate on improvement of quality and expansion of production of crops for export to Japan--corn, sorghum, oilseeds, cassava, kenaf, and bananas and other fruits.

Japanese assistance to Thailand is part of a larger Japanese plan to help countries in the Far East and other areas of the world increase their production of certain crops. Japan can thus diversify its sources of farm imports and expand its sale of industrial commodities (21). Additionally, Thailand wants Japanese assistance so as to reduce its large trade deficit with Japan.

In other bilateral assistance, Denmark has helped with dairy farming; Israel with cotton development and irrigation farming; West Germany with farm mechanization, land settlement, and dairy farming; and the Netherlands with land consolidation. The United Kingdom has contributed to cotton research and ginning development, while France has provided extension assistance for this crop (49). Australia has provided experts for research on irrigation cropping; Canada participates in a program for higher agricultural education at the University of Khon Kaen, as does New Zealand, which also helps in pasture development. All aid from the members of the British Commonwealth is supplied under the Colombo Plan (49).

Assistance from the United Nations, either directly or through its specialized agencies, has been available for several projects including those for rice protection, an experiment and demonstration farm for irrigated agriculture, rubber development, and soil fertility. Help has also been received in the form of experts and fellowships in agricultural statistics, animal health, locust control, nutrition, and soil and irrigation agronomy (13). The Asian Development Bank is helping in rural development.

Finally, Thailand has received important assistance from private sources These include the Rockefeller Foundation (plantbreeding--corn, sorghum, and rice) and the Asia Foundation (farm management). Private foreign firms engaged in activities related to agriculture have also been a significant source of technical aid in crop production and marketing.

Foreign Trade Policy

For several years before 1969, Thailand was able to offset a large trade deficit and maintain a favorable balance of payments through capital transfers resulting largely from foreign aid, U.S. Government expenditures in Thailand, tourist revenues, and foreign investments.

The surplus in the balance of payments and relatively large reserves of foreign exchange enabled Thailand to keep its imports essentially free of monetary and quantitative restrictions. However, the trade deficit widened rapidly in the late 1960's, primarily because of the fast increase in nonfarm imports; it was more than $1/2 billion in 1969 and again in 1970 (see section on "Trade Patterns"). In 1969, the balance of payments showed its first deficit (some $48 million) in about a decade. In 1970, the deficit was considerably higher, amounting to $128 million. By the end of that year, total gold and foreign exchange reserves were down to $746 million, compared with $922 million at the end of 1968 (51). Prospects for a quick return to a surplus position in the balance of payments are not favorable for several reasons: The international demand for a number of Thai export commodities is weak; imports are likely to continue at high levels; and U.S. military expenditures in Thailand are declining.

The Government continues to maintain a basic policy of unrestricted international trade. No exchange controls are imposed; and no arrangements are made for bilateral payments. Nevertheless, the Government has begun taking action aimed at improving the balance of payments. It has introduced fiscal measures to curtail luxury-type imports and encourage exports, and is apparently intensifying its export promotion activities, as well as the effort to increase foreign sales through negotiated international arrangements. In 1970, Thailand raised the import tariff on more than 200 commodities including tobacco and certain processed foods, mostly of the convenience type. The Government also increased the business tax on a number of products, which was meant not only to raise its revenues, but also to act as a deterrent to imports.

Since the trade deficit with Japan accounts for as much as 60 percent of Thailand's total trade deficit, the Thai Government is making a particular effort to correct this part of the trade imbalance. Following negotiations conducted by semiofficial economic groups, the Japanese agreed in 1970 to increase their purchases of several Thai farm commodities (49). Thailand is also seeking new or larger markets in other parts of Asia, West and East Europe, and Africa.

Over the past several years, Thailand has signed a number of bilateral commercial agreements with foreign Governments. These agreements, however, do not set any trade quotas. They are currently in effect with some 20 countries, including the United States. The first trade agreement with the Soviet Union was signed at the end of 1970. In return for industrial goods, Thailand is to export tin, rubber, and cassava flour to the Soviet Union, which may also purchase rice. Government-to-government agreements for the sale of rice are in effect with a number of countries (see section on "Rice").

Aside from the restraints introduced in 1970, the Government exercises other controls on international trade, mainly to regulate domestic supply and prices of certain commodities and to protect local producers. Certain commodities are subject to individual export licensing. Among these are rice, corn, sorghum, live cattle and other live animals, and raw sugar. Exports of rough rice and rice bran are prohibited.

Rice is occasionally put under quantitative export controls to prevent shortages of domestic supplies and sharp increases in internal prices. At times, exports of corn are also controlled to help fulfill the terms of the annual agreements with foreign countries (see section on "Corn").

No export subsidies are currently in effect, but rice exporters are permitted to quote prices up to 3 percent below minimum export price set by the Rice Price Commission and may grant specified rebates to regular or large customers; in all cases, the difference is made up to the exporter by the Government.

Imports normally on the prohibited list are few and mostly nonagricultural. They include sugar, certain textiles, some types of rice-milling machinery, urea, and ammonium sulfate. Quantitative restrictions are applied to tobacco imports, which are made under the control of the Tobacco Monopoly, but exports of leaf are unrestricted.

Trade with Mainland China, North Korea, and North Vietnam is prohibited, but no control is exercised on transshipments. All trade with Rhodesia is subject to individual licenses. There is no discrimination on trade with any other nation. The single-column tariff system is in effect (49), (51).

Trade Patterns

As with most other developing countries, farm products make up the bulk of Thailand's exports and a small portion of total imports. Agricultural exports are the major source of foreign exchange earnings, but their relative importance in total trade is declining. Agricultural commodities accounted for 86 percent of total exports in 1961, about 80 percent in 1965, and 73 percent in 1969. (Total Thai exports, f.o.b., amounted to $708 million in 1969 and a preliminary figure is $701 million for 1970.) The share of farm products in total imports has also decreased somewhat--from more than 10 percent in 1961 to less than 8 percent in 1969. (Total Thai imports, c.i.f., were $1,248 million in 1969 and $1,256 million in 1970.)

Dairy products, tobacco, cotton, and wheat (including flour) are Thailand's major agricultural imports (tables 20 and 21). The United States--which provides nearly all the tobacco and most of the cotton--is the largest single supplier. It had nearly 41 percent of the market in 1969.

The Netherlands is the chief source of dairy products, which are the largest group of Thai farm imports. Australia sells most of the wheat and wheat flour imported by Thailand.

A new market has begun to develop for a variety of convenience and packaged foods, primarily for the Bangkok-Thon Buri metropolitan area. However, the expansion of imports of this type of goods may be hindered, at least for the short run, by the Government's decision to curtail luxury-type imports.

Three commodities--rice, rubber, and corn--account for about three-fourths of the value of Thai farm exports (tables 22 and 23). As previously noted, Thailand is the world's second largest exporter of rice and one of the chief exporters of corn and natural rubber. It is also a major source of kenaf and tapioca products, and a world leader in castor seed exports.

Rice remains the most important export commodity, but its role is much reduced. In the late 1940's, rice accounted for about half of total exports (including nonagricultural commodities). Through 1969, rubber was the second most valuable farm export, but earnings from this product are likely to decline. Foreign sales of corn have expanded very rapidly and may soon move ahead of rubber in export value. Exports of corn go primarily to Japan and Taiwan.

Partly because of large purchases of Thai corn--which competes with U.S. feed grains--and rubber, Japan is Thailand's principal market for farm commodities.

Malaysia, Hong Kong, and Singapore have traditionally been important markets for Thai rice and continue to rely heavily on Thailand for this commodity. But Thailand's dependence on these markets has been lessened by its newer farm exports.

The EEC has become an important outlet for Thai rubber, cassava products, and kenaf. India is a market for Thai kenaf, as well as rice. In 1969, the United States took nearly 6 percent of Thailand's farm exports, by value, compared with about 9 percent in 1961 and 3.6 percent in 1965.

U.S. Trade with Thailand

Trade between the United States and Thailand is mostly in nonagricultural commodities. Nevertheless, the two countries exchange a sizable amount of farm products (tables 24 and 25).

The value of U.S. farm exports to Thailand increased from $8.3 million in 1958 to $38.3 million in 1968, but leveled off at some $32 million in 1969 and 1970. In the first half of 1971, exports totaled $23.2 million, compared with $13.1 million is the first half of 1970. The large increase resulted mainly from the near tripling of cotton exports and a strong surge in tobacco sales.

As previously discussed, tobacco and cotton are the chief U.S. agricultural exports to Thailand and are likely to remain so for the next several years. (More details concerning sales prospects for these two crops are in the sections on "Tobacco" and "Cotton.")

Of the other U.S. exports of farm origin to Thailand, liquid beverage bases and flavoring extracts and sirups are among the most important.

Since 1966, U.S. exporters have gained a sizable share of the Thai wheat market, supplying both Dark Northern Spring wheat and Western White wheat. Competition is strong from Australian suppliers, who enjoy an advantage in transportation costs, but prospects for sales of U.S. wheat to Thailand are favorable.

Except for wheat, U.S. sales of food products to Thailand consist largely of dried milk and canned or packaged goods of the convenience or luxury type, mostly for the tourist trade. Sales of dairy products have consisted primarily of nonfat dried milk--a large share of which is for relief--but in 1969 and 1970, relatively large shipments of whole dried milk were made.

In some years, livestock for breeding are imported from the United States.

The mid-1970 increases in business taxes and import tariffs in Thailand apply to most foods of the type imported from the United States, but it is not likely that American sales will be eliminated in any single category on which the higher levies have been imposed. Consumers of these products can generally afford to pay the resulting higher prices (51).

U.S. exports to Thailand have been helped by cooperative market-development efforts of agencies of the U.S. Government and private trade groups (50). For instance, the Wheat Associates have an ad hoc program with good potential; the Grain Associates, operating out of Tokyo, are aiding in promoting the expansion of the livestock sector.

U.S. imports of farm products from Thailand have increased in the past few years, averaging $26.5 million in 1969-70. However, they remain well below the level of the 1950's, when purchases of crude rubber were considerably larger then they are today (table 25). Crude rubber remains the major Thai farm export to the United States--$11.9 million in 1970. Farm products used to account for the bulk of U.S. imports from Thailand, but tin and tin alloys are now the most important items.

Tapioca flour is the second major U.S. farm import from Thailand. The relative importance of other commodities--jute and kapok, for example--has changed over the past several years (table 25). Sugar is a new and relatively important Thai product finding an outlet in the United States. Canned pineapple is another new Thai product moving into the U.S. market.

AGRICULTURAL PROSPECTS

According to official Thai data, aggregate agricultural production, including forestry and fisheries, increased nearly 5 percent annually during the period of the First Development Plan (1961-66). The target annual growth rate for the period of the Second Development Plan (1967-71) is somewhat lower--4.3 percent per year--but continues to exceed the estimated 3.1-percent annual increase in population.

In 1967, agricultural output was much lower than in 1966 because of unusually adverse weather conditions. Farm production recovered considerably in 1968, and by 1969 it had risen above the previous record level of 1966. This growth continued in 1970.

The overall trend of significant growth is also reflected in production indices compiled in the Foreign Regional Analysis Division, USDA. According to these, Thailand's 1970 agricultural production (not counting livestock) was 37 percent higher than in 1961-65, while total agricultural production of all less-developed countries (including livestock in most cases) was up only 22 percent. The per capita index of farm production was 109 for Thailand, compared with 102 for all less-developed countries, 106 for East Asia excluding Japan, and 110 for the developed countries. In fact, Thailand's percentage increase in per capita agricultural production is among the highest in the developing world and higher than in a number of developed nations.

Agricultural production in Thailand is expected to continue increasing in view of the Government's growing involvement in agricultural planning, anticipated technological advances, improvement of the infrastructure, and increase in commercialization. The rise in total output may accelerate in a few years, when the various Government programs--such as those for irrigation and agricultural research--make their full impact.

Lack of widespread technical knowledge and inadequacy of development capital are limiting factors. However, as previously noted, there is great scope for increasing yields in Thailand for virtually all crops, as well as livestock. For a few more years, there is also scope for opening up new land for cultivation. Double cropping, made possible by irrigation during the dry season, is becoming important and holds considerable promise for the future.

While serious attempts are being made to develop the more backward regions of the country, the greatest potential for expansion of farm production is in the Central Plain. The Government is also promoting this region's further development. Past agricultural growth has been largely concentrated there.

Rice is expected to remain the most important crop. Its output will continue to expand but other crops may have a somewhat faster rate of growth. 11/ The outlook for corn is continued growth, which could accelerate if large-scale Japanese assistance for corn production is provided. Crops such as oilseeds, sorghum, cassava, and bananas and other fruits have a good long-term potential, but the short-term prospect for most of them is only moderate growth. Output of oilseed is expected to be stimulated by domestic as well as foreign demand.

Because of the unfavorable export situation, the outlook for rubber and kenaf is uncertain. The slack international demand for sugar also puts a constraint on the expansion of sugar production in Thailand. Long-range prospects for expanding cotton output for domestic use are favorable, despite the current setback. For the foreseeable future, however, great reliance will

11/ Concerning rice, the point has been made that because of Thailand's increasing population and rising levels of consumption, Thailand's position will change in the late 1970's from one of rice surplus to one of rice deficit. (See Edward Van Roy, The Malthusian Squeeze on Thailand's Rice Economy, Asian Survey, Institute of International Studies, University of California, Berkeley, Vol. VII, no. 7, July 1967.) However, based on all evidence now available, Thailand should continue meeting domestic requirements for rice and have surpluses for export.

continue to be placed on imports. Local production of high-quality tobacco is also expected to fall short of domestic needs; and all wheat requirements will continue to be met through imports.

Livestock and poultry offer considerable opportunities for development, because incomes of domestic consumers have grown rapidly and may rise further. However, expansion of livestock production requires high-level integrated planning and modification of present meat marketing arrangements (43). Production of beef for export is quite a few years away; imports of high-quality beef will be necessary for many more years. Self-sufficiency in dairy products is not within reach.

Table 1.--Land use, Thailand, 1963

Use	Total	As percentage of total
	1,000 hectares	Percent
Rice	6,954	13.5
Other field crops	798	1.6
Fallow and other unused arable land	670	1.3
Tree crops	1,360	2.6
Farms with area of less than 0.32 hectare 1/	8	2/
Farm pastureland	90	.2
Total cultivated area	9,880	19.2
Farm woodland	952	1.9
Other farm area	317	.6
Total farm area	11,149	21.7
Other land areas and water bodies	40,251	78.3
Total 3/	51,400	100.0

1/ The entire area of these farms is assumed to be under cultivation.
2/ Insignificant.
3/ Figures do not always add because of rounding.

Source: (42).

Table 2.--Number and area of farms, by size group, Thailand, 1963

Size group 1/	Number of farms		Total area	
	1,000	Percent	1,000 hectares	Percent
Less than 0.9 hectares	595.1	18.5	284.8	2.6
0.9 to 1.6	458.2	14.3	540.7	4.8
1.6 to 5.6	1,563.2	48.6	4,838.9	43.4
5.6 to 9.6	423.5	13.2	3,006.8	27.0
9.6 to 16.0	137.5	4.3	1,600.4	14.3
16.0 and over	36.9	1.1	877.6	7.9
Total	3,214.4	100.0	11,149.2	100.0

1/ Converted from Thai unit of land measurement--the rai. One rai = 0.16 hectare = 0.395 acre.

Source: (42).

Table 3.--Number and area of farms, by type of tenure, Thailand, 1963

Type of tenure	Number of farms		Total area	
	1,000	Percent	1,000 hectares	Percent
Full or part owner	2,633.0	81.9	9,485.5	85.1
Cash renter	60.2	1.9	137.8	1.2
Crop renter	70.8	2.2	286.8	2.6
Other 1/	450.4	14.0	1,239.1	11.1
Total	3,214.4	100.0	11,149.2	100.0

1/ Includes farm operators renting land on both cash and crop basis, occupants of cleared and unclaimed land, users of rent-free land, squatters, users of land in exchange for services, and persons using land in lieu of receiving payment of mortgage held on that land.

Source: (42).

Table 4.--Farms by type of power and equipment used, Thailand, 1963

Type of power and equipment used	Number of farms	Proportion of total
	1,000	Percent
Manpower only	447	14.5
Animal power only	2,181	70.7
Mechanical power only	100	3.2
Animal and mechanical power	359	11.6
Total farms	1/3,087	100.0
Tractors	183	5.9
Threshers	59	1.9
Sprayers	136	4.4
Electric or gas motor	224	7.3
Windmills and water wheels	17	.6

1/ Excludes 127,000 holdings with less than 0.32 hectare.

Source: (42).

Table 5.--Consumption of commercial fertilizers, Thailand, average 1951/52-1965/66, annual 1961/62-1968/69

Period or year 1/	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
	1,000 metric tons 2/		
Average:			
1951/52-1955/56	2.4	0.9	1.6
1956/67-1960/61	7.5	2.9	1.7
1961/62-1965/66	15.2	8.7	3.8
1961/62	11.1	4.7	2.1
1962/63	12.3	6.5	3.0
1963/64	18.4	11.1	4.3
1964/65	16.2	9.9	4.7
1965/66	17.9	11.3	4.6
1966/67	34.8	24.3	7.9
1967/68 3/	52.2	35.7	12.7
1968/69 3/	50.0	40.0	15.0

1/ Year beginning July 1.
2/ Plant nutrient content.
3/ Preliminary.

Principal source: FAO. Fertilizers, An Annual Review of World Production, Consumption, and Trade, various issues.

Table 6.--Principal crops: Area, production, and net trade, Thailand, 1969

Crop	Planted area 1/	Yield per hectare	Production	Net trade
	1,000 hectares	Quintals	- - 1,000 metric tons - -	
Rice, milled 2/	7,230	11.3	8,191	-1,023
Corn	720	23.6	1,700	-1,476
Rubber	3/637	...	282	-276
Cassava (root)	154	142.9	2,200	4/-2,508
Coconuts	272	46.5	1,265	5/
Oilseeds:				
Peanuts (shelled)	112	10.7	120	-6
Soybeans	48	8.3	40	-5
Cottonseed	6/	5.5	72	-54
Sesame seed	31	6.8	21	-4
Castor beans	38	10.5	40	-30
Kapok seed	7/	...	72	-4
Kenaf fiber	327	10.4	341	-226
Cotton, lint 2/	130	2.8	36	+11
Kapok fiber 8/	60	14.5	87	-20
Tobacco	9/83	...	9/41	+4
Sugar 2/	10/118	43.4	512	-16
Mung beans	142	12.7	180	-77

+ = imports. - = exports.
na = not available.
... = not applicable.
1/ Harvested area for cotton and tobacco; tappable area for rubber.
2/ Area and production for crop year beginning previous year and extending into the year shown.
3/ 1967.
4/ Exports taken in part from stocks.
5/ Insignificant amount.
6/ Area under cotton.
7/ 1969 area not available; 1968 area shown under kapok fiber.
8/ 1968.
9/ Area for 1968. Commercial production only.
10/ Area in sugarcane.

Sources: See tables for individual crops and related text.

Table 7.--Rice: Area, production, and exports, Thailand, average 1951/52-1965/66, annual 1961/62-1971/72

Period or crop year 1/	Comparison of area and production as reported by--2/						Exports 1/
	Thailand's Ministry of Agriculture (Rice Department)			Thailand's National Statistical Office (NSO)			
	Planted area	Harvested area	Production, paddy	Planted area 3/	Production 4/ Paddy	Production 4/ Milled 5/	
	1,000 hectares		1,000 metric tons	1,000 hectares	1,000 metric tons		
Average:							
1951/52-1955/56	6,053	5,339	7,042	na	8,189	5,405	1,282
1956/57-1960/61	5,893	5,225	7,105	na	8,268	5,457	1,315
1961/62-1965/66	6,491	6,019	9,252	na	10,419	6,876	1,598
1961/62	6,179	5,656	8,177	na	9,591	6,330	1,271
1962/63	6,659	6,191	9,279	na	9,856	6,505	1,418
1963/64	6,601	6,354	10,029	na	10,799	7,127	1,896
1964/65	6,539	5,971	9,558	na	11,070	7,306	1,895
1965/66	6,479	5,925	9,218	na	10,778	7,113	1,508
1966/67	7,309	6,878	11,975	3/7,482	13,500	8,910	1,482
1967/68	6,410	5,601	9,595	6,662	11,198	7,391	1,022
1968/69	7,149	6,259	10,772	7,230	12,410	8,191	1,023
1969/70 6/	na	na	na	7,584	13,410	8,851	1,029
1970/71 6/	7,637	na	13,346	7,600	13,270	8,758	1,000
1971/72 6/	7,800	na	13,400	na	na	na	na

na = not available.

1/ Exports for calendar year in which harvest is completed; for example, exports shown for 1968/69 are for calendar year 1969. 2/ Does not include second or dry season crop. Area and production of dry season crop were negligible through 1965, but have become significant since then. However, area and amounts harvested are virtually impossible to determine. An unofficial estimate put the 1968 planted area at some 120,000 hectares and output at 450,000 tons of paddy (50). 3/ Estimates of harvested area by NSO are not available, except for 1966/67, when a harvested area of 7,355 hectares was reported. 4/ Production estimates by NSO for 1951/52-1965/66 are based on the production estimates of the Rice Department; in most cases they were arrived at by increasing the Rice Department's estimates by 15 percent. 5/ Converted at the rate of 66 percent of paddy. 6/ Preliminary or forecast.

Principal sources: (30), (37), (49).

Table 8.--Rice exports, by country of destination, Thailand, 1955-70

Calendar year	Total	Aden	Ceylon	Hong Kong	India	Indonesia	Japan
	1,000 metric tons						
1955	1,235	2	12	171	2	66	370
1956	1,264	6	--	186	6	167	142
1957	1,570	16	45	192	5	179	146
1958	1,133	22	--	171	--	131	72
1959	1,092	26	--	163	--	75	93
1960	1,203	25	8	180	--	138	90
1961	1,576	13	62	195	--	376	51
1962	1,271	23	45	219	--	266	64
1963	1,418	25	37	190	--	340	105
1964	1,896	39	30	205	35	452	128
1965	1,895	22	186	205	214	109	152
1966	1,508	18	112	214	181	167	92
1967	1,482	21	98	214	184	177	137
1968	1,022	15	56	129	207	38	90
1969	1,023	13	31	174	114	81	63
1970	1,029						

	Malaysia	Netherlands	Philippines	Saudi Arabia	Singapore	United Kingdom	Other
	1,000 metric tons						
1955	196	40	57	2	246	9	62
1956	216	57	31	12	302	20	119
1957	224	52	105	70	269	26	241
1958	193	44	47	44	222	45	142
1959	267	30	--	94	218	25	101
1960	239	17	--	86	209	19	192
1961	248	12	141	58	195	33	192
1962	199	32	--	71	173	23	156
1963	251	6	71	69	177	16	131
1964	294	32	109	65	228	20	259
1965	271	18	130	77	172	22	317
1966	154	23	49	53	143	11	291
1967	204	1	100	62	119	6	159
1968	154	4	--	69	129	2	129
1969	137	2	--	66	134	9	199

-- indicates no or insignificant exports.

Sources: (45); Annual Statement of Foreign Trade of Thailand, various issues; and (49).

Table 9.--Corn: Area, production, and exports, Thailand, average 1951-65, annual 1961-71

Period or year	Area harvested 1/	Yield per hectare	Production	Exports
	1,000 hectares	Quintals	1,000 metric tons	
Average:				
1951-55	48	11.2	54	38
1956-60	157	16.6	260	212
1961-65	422	19.3	815	740
1961	298	20.1	598	567
1962	321	20.7	665	472
1963	388	22.1	858	744
1964	541	17.3	935	1,115
1965	562	18.2	1,021	804
1966	590	19.0	1,122	1,219
1967	670	18.1	1,212	1,091
1968	704	21.3	1,500	1,481
1969	720	23.6	1,700	1,476
1970	720	27.1	2/1,950	1,371
1971 2/	720	30.6	2,200	1,400

1/ Planted area for 1968-70.
2/ Preliminary or forecast.

Sources: (30); (49); and Annual Statement of Foreign Trade of Thailand, various issues.

Table 10.--Corn exports, by country of destination, Thailand, 1955-70

Calendar year	Total 1/	Hong Kong	Italy	Japan	Malaysia	Singapore	Taiwan	Other
	1,000 metric tons							
1955	68	34	--	18	5	11	--	--
1956	81	18	--	37	14	13	--	--
1957	64	3	--	36	15	10	--	--
1958	163	4	--	130	14	15	--	--
1959	237	10	--	189	20	18	--	--
1960	515	11	--	411	25	35	2	32
1961	567	44	--	338	31	82	1	71
1962	472	103	--	229	46	92	--	2
1963	744	112	35	453	50	79	10	5
1964	1,115	108	14	845	51	74	10	13
1965	804	82	--	560	54	82	9	17
1966	1,219	77	12	826	67	142	57	38
1967	1,091	83	8	671	70	100	144	15
1968	1,481	131	--	665	110	146	395	34
1969	1,476	132	15	487	110	155	450	127
1970	1,371							

-- indicates no or insignificant exports.

1/ Figures do not always add because of rounding.

Sources: Annual Statement of Foreign Trade of Thailand, 1955-69; and (49).

Table 11.--Imports of wheat and wheat flour, by country of origin, Thailand, 1955-70

Calendar year	Total 1/		United States		Australia		Canada		Japan		Other	
	Wheat	Wheat flour	Wheat	Wheat flour	Wheat	Wheat flour	Wheat	Wheat flour	Wheat	Wheat flour	Wheat	Wheat flour
	1,000 metric tons											
1955	1	24	--	--	--	14	--	6	--	--	1	3
1956	1	26	--	--	--	15	--	7	--	--	1	3
1957	1	30	--	1	--	16	--	12	--	--	1	1
1958	1	26	--	2	--	14	--	7	--	2	1	1
1959	--	25	--	2	--	13	--	7	--	3	--	2
1960	--	23	--	1	--	12	--	6	--	2	--	1
1961	--	25	--	2	--	13	--	6	--	2	--	2
1962	--	26	--	1	--	15	--	7	--	3	--	1
1963	--	29	--	1	--	17	--	8	--	3	--	1
1964	10	24	--	2	7	11	3	8	--	1	--	2
1965	12	17	--	2	9	7	4	6	--	--	--	2
1966	41	14	10	1	26	6	6	5	--	1	--	1
1967	41	12	10	1	31	5	--	5	--	--	--	1
1968	40	13	7	1	33	7	--	4	--	--	--	1
1969	49	11	8	1	38	4	1	3	--	--	2/3	3
1970 3/	65	11	16	1	49	4	na	--	na	na	na	na

-- indicates no or insignificant exports.
na = not available.
1/ Figures do not always add because of rounding
2/ Almost entirely from France.
3/ Preliminary.

Source: Annual Statement of Foreign Trade of Thailand, 1955-69; and (49).

Table 12.--Rubber: Area, production, and exports, Thailand, average 1951-65, annual 1961-70

Period or year	Tappable area	Yield per hectare	Production	Exports 1/
	1,000 hectares	Quintals	1,000 metric tons	
Average:				
1951-55	284	4.0	113	117
1956-60	353	4.3	152	150
1961-65	429	4.7	201	199
1961	400	4.7	186	185
1962	416	4.7	195	194
1963	430	4.6	198	187
1964	444	4.8	211	217
1965	456	4.8	217	211
1966	533	4.1	218	203
1967	637	3.4	219	211
1968	na	na	255	249
1969	na	na	282	276
1970	na	na	281	na

na = not available.
1/ Natural rubber and similar natural gums.

Principal source: (30).

Table 13.--Oilseeds: Area, production, and exports, Thailand, average 1951-65, annual 1964-70

Item	Average, 1951-55	Average, 1956-60	Average, 1961-65	1964	1965	1966	1967	1968	1969 1/	1970 1/
					1,000 hectares					
Area harvested: 2/										
Peanuts	74	97	86	87	95	153	104	101	112	120
Soybeans	22	23	27	34	18	44	58	45	48	51
Cottonseed 3/	37	40	60	70	66	72	79	97	130	64
Sesame seed	16	20	18	16	25	29	33	30	31	30
Castor beans	12	25	39	38	33	42	46	35	38	40
Kapok seed 3/	na	4/54	42	48	50	48	47	60	na	na
Total listed	na	259	272	293	287	388	367	368	na	na
					1,000 metric tons					
Production:										
Peanuts (shelled)	50	74	70	72	78	132	79	95	120	132
Soybeans	21	24	27	31	19	38	53	5/37	5/40	5/45
Cottonseed	16	22	30	32	33	40	59	54	72	36
Sesame seed	9	17	15	13	18	20	23	22	21	20
Castor beans	17	32	40	39	32	42	38	43	40	42
Kapok seed	na	4/89	62	75	76	71	63	70	72	na
Total listed	na	258	244	262	256	343	315	321	365	na
Oil-equivalent: 6/										
Castor oil	8	14	18	18	14	20	17	19	18	19
Edible oil	na	64	58	61	64	92	74	79	93	na
Exports:										
Peanuts (shelled or unshelled)	19	14	15	12	18	18	8	5	6	na
Soybeans	3	4	3	4	2	6	6	4	5	na
Cottonseed	3	6	10	15	9	18	31	47	54	na
Sesame seed	2	4	4	3	4	5	4	4	4	na
Castor beans	16	24	38	36	28	44	33	27	30	na
Kapok seed	2	10	24	21	31	28	8	14	4	na
Total listed	45	62	94	91	92	119	90	101	103	na
Oil-equivalent: 7/										
Castor oil	7	11	17	16	13	20	15	12	14	na
Edible oil	11	12	15	14	17	19	12	14	14	na

na = not available.

1/ Preliminary. 2/ Planted area from 1968-70, except for cottonseed. 3/ Area in cotton and kapok, respectively. 4/ 4-year average (1957-60). 5/ Unofficial estimates. According to other sources, production is much higher than shown here; for example (6) puts the 1969 production at 143,000 tons. 6/ See text concerning amounts actually pressed into oil. 7/ Excludes exports of oil, which are small (see text).

Sources: (30); (49); and Annual Statement of Foreign Trade of Thailand, various issues.

Table 14.--Kenaf fiber: Area, production, and exports, Thailand, average 1951-65, annual 1961-70

Period or year	Area harvested 1/	Yield per hectare	Production	Exports
	1,000 hectares	Quintals	1,000 metric tons	
Average:				
1951-55	10	13.0	13	2
1956-60	47	12.6	59	19
1961-65	224	13.5	303	197
1961	269	12.6	339	143
1962	112	12.0	134	237
1963	152	13.9	212	125
1964	215	14.1	303	162
1965	373	14.2	529	317
1966	498	13.3	661	473
1967	343	12.3	421	274
1968	119	11.7	139	257
1969	327	10.4	341	226
1970	336	11.9	400	na

na = not available.
1/ Planted area for 1968-70.

Sources: (30); (49); and Annual Statement of Foreign Trade of Thailand, various issues.

Table 15.--Cotton, lint: Area, production, and net imports, Thailand, average 1951/52-1965/66, annual 1961/62-1969/70

Period or year 1/	Area harvested	Yield per hectare	Production	Net imports
	1,000 hectares	Quintals	1,000 metric tons	
Average:				
1951/52-1955/56	37	2.2	8	1
1956/57-1960/61	45	2.7	12	3
1961/62-1965/66	64	2.5	16	15
1961/62	53	2.5	13	8
1962/63	58	2.4	14	9
1963/64	70	2.3	16	10
1964/65	66	2.4	16	25
1965/66	72	2.8	20	24
1966/67	79	3.8	30	25
1967/68	97	2.8	27	19
1968/69	130	2.8	36	11
1969/70	2/64	2.8	2/18	na

na = not available.

1/ Trade for calendar year in which harvest is completed; for example, trade shown for 1968/69 is for calendar year 1969.

2/ Estimate by office of U.S. Agricultural Attaché. According to estimates of Thailand's Department of Agriculture for the same crop year, harvested area was 82,000 hectares, production 31,000 tons.

Sources: (30); (49); and Annual Statement of Foreign Trade of Thailand, various issues.

Table 16.--Imports of cotton, by country of origin, Thailand, 1955-69

Calendar year	Total	United States	Brazil	Burma	Hong Kong	Laos	Mexico	Nicaragua	South Africa	Other
					Metric tons					
1955	1,528	--	--	--	1,420	19	--	--	--	89
1956	607	--	--	62	492	47	--	--	--	6
1957	60	--	--	32	--	27	--	--	--	1
1958	705	228	--	44	192	239	--	--	--	2
1959	1,981	914	--	374	576	111	--	--	--	6
1960	4,887	3,928	--	61	605	83	--	--	--	210
1961	8,681	7,090	94	1	780	102	--	--	--	614
1962	7,741	5,850	790	--	--	57	753	--	--	291
1963	9,250	6,634	459	--	23	43	1,257	--	--	834
1964	10,472	7,594	1,597	--	--	67	572	296	--	346
1965	24,714	17,846	1,174	--	23	21	2,456	2,822	141	231
1966	24,212	15,893	1,386	--	--	32	4,350	811	846	894
1967	24,715	18,189	2,607	--	--	15	1,966	372	569	997
1968	22,305	21,098	145	--	--	32	584	51	47	348
1969	17,183	14,154	1,879	--	--	106	589	205	--	250

-- indicates no or insignificant imports.

Source: Annual Statement of Foreign Trade of Thailand, 1955-69.

Table 17.--Tobacco: Area, production, and trade, Thailand, average 1956-65, annual 1961-71

Period or year	Harvested area 1/	Total production 1/			Commercial production 2/	Trade	
		Local varieties	Virginia type	Total		Exports	Imports
	1,000 hectares	1,000 metric tons					
Average:							
1956-60	59	58	8	66	26	4	5
1961-65	49	48	9	57	31	4	5
1961	41	40	9	49	29	1	6
1962	41	39	9	48	30	3	4
1963	40	38	9	47	30	4	4
1964	51	54	9	63	31	6	5
1965	70	68	8	76	35	6	6
1966	84	81	8	89	36	8	9
1967	62	70	8	78	36	9	9
1968	83	na	na	90	37	10	14
1969	na	na	na	na	41	8	12
1970	na	na	na	na	42	na	na
1971	na	na	na	na	3/43	na	na

na = not available.
1/ Data by Thailand's Ministry of Agriculture for 1956-67 and 1969 FAO Production Yearbook for 1968.
2/ Quantities entering commercial channels through the Thai Tobacco Monopoly. These are the data generally used in the U.S. Department of Agriculture when referring to Thailand's tobacco production.
3/ Forecast.

Principal sources: (30); (49); and Annual Statement of Foreign Trade of Thailand, various issues.

Table 18.--Sugarcane, area and production; and sugar, production and net trade, Thailand, average 1950/51-1964/65, annual 1960/61-1970/71

Period or year 1/	Sugarcane			Sugar 3/		
	Area harvested 2/	Yield per hectare	Production	Production		Net trade 1/
				Centrifugal	Noncentrifugal	
	1,000 hectares	Quintals	1,000 metric tons			
Average:						
1950/51-1954/55	74	213	1,573	36	21	+22
1955/56-1959/60	126	317	3,995	90	52	+8
1960/61-1964/65	138	324	4,465	184	132	-47
1960/61	157	343	5,382	155	116	-2
1961/62	123	324	3,984	151	125	-44
1962/63	100	315	3,154	125	130	-54
1963/64	148	320	4,733	168	140	-50
1964/65	161	315	5,074	320	150	-85
1965/66	140	320	4,480	269	150	-55
1966/67	123	311	3,829	232	165	-15
1967/68	141	321	4,526	226	180	4/
1968/69	118	411	4,854	317	195	-16
1969/70	133	420	5,582	407	210	5/-31
1970/71	147	425	6,250	528	225	5/-50

+ = imports. - = exports.

1/ Harvesting and milling season beginning in November and ending in May. Trade for calendar year in which harvesting and milling are completed; for example, trade shown for 1968/69 is for calendar year 1969.

2/ Planted area for 1968/69-1970/71.

3/ Raw value (106 percent of weight of refined sugar) except after 1966/67, when the product weight of the combined output of raw and refined sugars is given. Weight of noncentrifugal sugar reported as such.

4/ Insignificant amount.

5/ Forecast.

Sources: (30); (49); and FAO Production and Trade Yearbooks, various issues.

Table 19.--Number of livestock on farms, Thailand, average 1951-65, annual 1961-69

Period or year 1/	Buffaloes	Cattle	Hogs	Horses, mules, and donkeys	Goats	Poultry
	1,000 head					
Average:						
1951-55	5,609	4,422	3,161	200	2/34	22,306
1956-60	6,213	5,009	3,826	188	2/37	33,361
1961-65	6,864	5,245	4,640	181	28	37,540
1961	6,749	5,099	5,246	181	27	32,972
1962	6,915	5,441	4,389	189	27	30,787
1963	7,087	5,347	4,467	179	27	35,050
1964	6,878	5,236	4,291	181	27	43,180
1965	6,691	5,104	4,805	175	30	45,711
1966	6,878	5,167	4,085	180	31	45,575
1967	6,900	5,600	4,400	3/177	na	4/67,000
1968	6,900	5,800	4,600	3/177	na	4/70,500
1969	na	6,000	5,000	na	na	4/75,000

na = not available.
1/ As of December of years shown.
2/ 3-year average.
3/ Horses only.
4/ Unofficial estimates, includes nonfarm raising.

Sources: (30); (49); and FAO, Production Yearbook, various issues.

Table 20.--Imports of selected agricultural products, by value, Thailand, 1955-69

Calendar year	Milk, condensed: Whole	Milk, condensed: Skimmed	Milk, dried	Wheat	Wheat flour	Tobacco	Cotton
	Million dollars						
1955	8.4	1.3	1.3	0.1	3.2	6.1	1.1
1956	7.8	1.8	.7	.1	3.4	6.9	.4
1957	10.1	2.9	1.1	.1	3.5	8.7	--
1958	9.9	2.6	1.1	.1	3.7	8.6	.3
1959	10.6	3.0	1.8	--	3.6	7.4	.8
1960	11.0	2.4	1.5	--	3.3	4.5	2.8
1961	11.0	2.1	2.1	.1	3.7	8.7	5.3
1962	12.3	2.2	2.1	--	2.9	6.1	4.7
1963	14.3	2.8	2.4	--	3.4	5.8	5.3
1964	14.2	3.1	2.7	.9	2.8	7.8	6.0
1965	13.5	2.3	3.1	1.0	2.1	8.2	14.0
1966	9.8	2.3	4.7	3.3	1.8	13.0	14.2
1967	7.0	2.0	5.8	3.1	1.6	13.8	13.3
1968	6.7	1.1	6.5	3.1	1.5	21.4	10.8
1969	4.8	.3	10.1	3.9	1.4	22.7	9.6

-- indicates no or insignificant imports.

Sources: (45) and Annual Statement of Foreign Trade of Thailand, various issues.

Table 21.--Agricultural imports, by commodity and country of origin, Thailand, 1969

Commodity	United States	Netherlands	Other Western Europe	Australia	Asia	Other	Total 1/	Percentage of total, by commodity
	Million dollars 2/							Percent
Dairy products	1.4	12.2	7.9	8.5	0.3	3.1	33.3	33.6
Tobacco	22.5	3/	3/	3/	.2	3/	22.7	22.9
Cotton	8.0	3/	3/	3/	3/	1.5	9.6	9.7
Wheat and flour	.8	3/	.3	3.6	.3	.4	5.3	5.4
Other grains and preparations	.1	.2	1.2	1.1	.2	.1	2.8	2.8
Coffee, tea, and cocoa	.7	.7	.1	.2	3.7	.2	5.7	5.8
Fruits, nuts, vegetables and preparations	1.0	.2	.5	.1	2.2	3/	4.2	4.2
Other	4/6.0	.4	2.7	.8	5/4.6	.9	15.4	15.6
Total 1/	6/40.5	13.7	12.8	14.3	11.6	6.2	99.0	100.0
Percentage of total, by origin	40.9	13.8	12.9	14.4	11.7	6.3	100.0	

1/ Value is c.i.f. Figures do not add to all totals because of rounding.
2/ Converted at the rate of 1,000 baht = US$48.08.
3/ Insignificant, if any.
4/ Mainly nonalcoholic concentrated extracts, valued at $3,700,000.
5/ Mainly crude vegetable material, valued at $1,600,000; fats and oils, $1 million; and spices, $500,000.
6/ Table 24, based on U.S. statistics, puts the value of U.S. farm exports to Thailand in 1969 at $32.1 million. After allowing for differences between f.a.s. and c.i.f. values and for the time elapsed between shipment and arrival of goods, the discrepancy remains unusually large. Perhaps, as was the case in 1966, Thai statistics include some commodities imported for consumption by U.S. military personnel in Thailand.

Source: Annual Statement of Foreign Trade of Thailand, 1969.

Table 22.--Exports of principal agricultural products, by value, Thailand, 1955-69

Calendar year	Rice	Corn	Cassava				Rubber	Kenaf
			Chips	Flour	Meal	Pellets and other		
	Million dollars							
1955	150.6	3.8	--	2.5	--	.7	86.6	--
1956	137.5	4.6	--	4.5	--	.8	73.4	--
1957	174.1	3.6	--	6.1	--	.5	67.6	--
1958	142.7	8.8	.1	8.5	--	.6	63.8	3.3
1959	123.8	12.0	--	9.3	--	1.4	112.3	4.1
1960	123.6	26.5	--	10.7	2.5	.7	124.0	10.9
1961	173.0	28.7	.3	13.4	7.2	.5	102.4	30.0
1962	155.8	24.1	.5	7.6	11.8	.4	101.5	27.6
1963	164.6	39.8	3.7	9.8	6.9	.8	91.5	17.1
1964	211.0	64.7	12.2	11.0	6.8	1.4	99.0	23.8
1965	208.4	46.6	15.1	10.7	2.9	3.7	96.1	53.0
1966	192.4	73.1	13.3	11.1	2.5	4.0	89.5	77.5
1967	223.7	65.1	11.3	14.6	6.8	2.2	75.7	41.6
1968	181.5	74.8	10.7	10.7	14.7	.9	87.3	32.4
1969	141.6	80.5	2.1	8.8	1.0	30.3	128.1	37.3

-- indicates no or insignificant exports.

Sources: (45) and Annual Statement of Foreign Trade of Thailand, various issues.

Table 23.--Agricultural exports, by commodity and country of destination, Thailand, 1969

Commodity	United States	Japan	Hong Kong	Singapore	Malaysia	India	Other Asia	EEC	Other	Total 1/	Percentage of total, by commodity
	Million dollars 2/										Percent
Rice 3/	4/	9.9	28.2	22.6	21.0	13.4	5/28.3	0.6	18.7	142.6	28.6
Rubber	15.4	47.0	.2	9.2	13.6	4/	1.2	22.4	19.0	128.1	25.7
Corn 3/	.1	25.2	8.4	10.9	7.5	4/	6/29.7	.8	2.3	85.0	17.1
Cassava	4.9	3.2	.2	.2	.5	4/	.2	32.5	.5	42.2	8.5
Kenaf	.7	9.5	4/	4/	4/	10.0	1.6	6.2	9.2	37.3	7.5
Oilseeds	4/	8.7	.4	.5	.8	4/	.2	.1	4/	10.7	2.2
Tobacco	.4	1.9	4/	.2	4/	4/	.2	2.4	2.1	7.2	1.4
Other	6.9	9.7	10.6	3.8	3.9	.7	5.9	1.7	1.6	44.7	9.0
Total	28.4	115.1	48.0	47.4	47.3	24.1	67.3	66.7	53.4	497.8	100.0
Percentage of total, by destination	5.7	23.1	9.7	9.5	9.5	4.9	13.5	13.4	10.7	100.0	

1/ Figures do not add to all totals because of rounding.
2/ F.o.b. value. Converted at the rate of 1,000 baht = US$48.08.
3/ Includes preparations.
4/ Insignificant, if any.
5/ Mainly to Indonesia, valued at $9,700,000; and Saudi Arabia, $8,500,000.
6/ Mainly to Taiwan, valued at $25 million.

Source: Annual Statement of Foreign Trade of Thailand, 1969.

Table 24.--U.S. agricultural exports to Thailand, average 1957-66, annual 1962-70

Commodity	Average, 1957-61	Average, 1962-66	1962	1963	1964	1965	1966	1967	1968	1969	1970
	1,000 dollars 1/										
Tobacco	7,435	7,787	5,328	6,485	7,750	7,614	11,759	15,658	21,374	19,100	16,149
Cotton	1,336	5,078	3,312	3,624	3,453	8,259	6,743	7,063	9,189	5,040	8,547
Flavored or colored sirups, molasses	2/	2/	2/	2/	2/	577	1,206	1,346	879	388	2
Liquid beverage bases, flavoring extracts, flavoring sirups, agents, n.e.c.	351	669	307	244	241	283	486	728	2,617	2,703	2,651
Dairy products	291	343	252	221	235	502	503	349	883	1,217	1,179
Grains and preparations	378	411	262	262	326	331	874	1,225	1,381	867	1,219
(Infants' and dietetic food)	(180)	(113)	(140)	(99)	(56)	(97)	(172)	(366)	(335)	(173)	(174)
Coffee	60	193	138	229	170	239	189	206	97	117	61
Other	593	928	623	799	923	888	3/1,409	3/1,603	3/1,891	3/2,629	3/2,047
Total agricultural	10,444	15,409	10,222	11,864	13,098	18,693	23,169	28,178	38,311	4/32,061	31,855
Nonagricultural	50,839	81,460	60,818	83,918	69,672	88,362	104,530	135,668	147,641	115,317	118,345
Total exports	61,283	96,869	71,040	95,782	82,770	107,055	127,699	163,846	185,952	147,378	150,200

1/ F.a.s. value.
2/ Included under flavoring extracts, and so on.
3/ Mainly fruits, nuts, vegetables, and preparations; miscellaneous food preparations; and animal feed.
4/ Table 21, based on Thai statistics, puts the value of U.S. farm imports from Thailand at $40.5 million. After allowing for differences between f.a.s. and c.i.f. values and for the time elapsed between shipment and arrival of goods, the discrepancy remains unusually large. Perhaps, as was the case in 1966, Thai statistics include some commodities imported for consumption by U.S. military personnel in Thailand.

Source: Bureau of the Census, agricultural specialist runs, 1957-70.

Table 25.--U.S. agricultural imports from Thailand, average 1957-66, annual 1962-70

Commodity	Average, 1957-61	Average, 1962-66	1962	1963	1964	1965	1966	1967	1968	1969	1970
					1,000 dollars 1/						
Crude rubber	50,101	10,906	23,006	20,133	6,290	2,519	2,582	3,023	11,242	13,133	11,883
Cassava and preparations, mostly tapioca	6,442	7,721	4,684	7,978	8,031	9,078	8,832	8,991	5,895	5,133	5,215
Kapok fiber	1,735	3,283	2,956	3,422	3,489	3,533	3,017	2,984	4,498	3,126	3,528
Jute and jute butts	101	1,240	2,429	1,008	895	1,375	491	1,245	797	583	1,028
Feathers, crude	114	233	163	179	155	245	424	67	461	296	127
Other	154	283	303	2/613	157	178	162	3/4,141	4/963	5/4,065	6/4,875
Total agricultural	58,647	23,666	33,541	33,333	19,017	16,928	15,508	20,451	23,856	26,336	26,656
Nonagricultural	6,601	20,416	5,602	5,827	5,637	24,421	60,594	75,550	56,916	65,429	73,344
Total imports	65,248	44,082	39,143	39,160	24,654	41,349	76,102	96,001	80,772	91,765	100,000

1/ F.o.b. value.
2/ Mostly gutta percha and guttas n.e.s., valued at $456,000.
3/ Mostly sugar valued at $3,899,000.
4/ Mostly canned pineapples valued at $770,000.
5/ Mostly sugar valued at $2,072,000 and canned pineapples valued at $1,305,000.
6/ Mostly sugar valued at $2,479,000 and canned pineapples valued at $1,600,000.

Source: Bureau of the Census, agricultural specialist runs, 1957-70.

APPENDIX

Livestock diseases, Thailand

Disease	Animal affected
Widespread incidence:	
Hemorrhagic septicemia	Cattle, buffaloes
Foot-and-mouth disease	Cattle, buffaloes, hogs
Hog cholera	Hogs
Newcastle disease	Poultry
Fowl pest	Poultry
Distomatosis	Cattle, buffaloes, sheep, hogs
Filariasis	Cattle, buffaloes
G.I. nematodiasis	All animals
Leptospirosis	Cattle, buffaloes, hogs
Moderate incidence:	
Anthrax	Cattle, buffaloes, hogs
Brucellosis	Cattle, buffaloes, hogs
Tuberculosis	Cattle, buffaloes, poultry
Fowl pox	Poultry
Cysticercosis	Cattle, buffaloes, hogs
Mange	All animals
Coccidiosis	Poultry
Glanders	Horses
Salmonellosis	All animals
Trypanosomiasis (Trypanosomia evansii)	Cattle, buffaloes, horses
Pasteurellosis	All animals
Low incidence:	
Melioidosis	Hogs
Actinomycosis	Cattle, buffaloes
Q-fever	Cattle, buffaloes, sheep
Trichinosis	Hogs
Encephalomyelitis	Horses
Anaplasmosis	Cattle, buffaloes
Echinococcosis	Cattle, buffaloes, hogs

Principal source: U.S. Department of Defense, Walter Reed Army Institute of Research, Kingdom of Thailand. Health Data Publ. no. 6, rev., Wash., D.C., Dec. 1966.

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